MACHINE DESIGN

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CONTENTS

Page

Centrifugal Force "Shoots" Abrasives 25
By Allen F. Clark

Scanning the Field for Ideas 28

Consider the Pump—Vital Factor in Machine Performance—Part I—Air Pumps 31
By Ormonde Bogert

Isolate Vibration—If It Must Be Present 34

Checking Theory with Tests in Bearing Design 37
By L. M. Tichvinsky

Special Materials Open Door to Design Success 40
By William C. Willard

Attractive Finishes Bring Boost in Sales (Book Review) 44

New Machines Indicate Design Trends 45

Design Features in New Machines 46

Knowledge Cannot Become "Specialized" without Broader Basic Foundation (Editorial) 48

Professional Viewpoints 49
Men of Machines 52
Obituaries 54
Noteworthy Patents 56
New Materials and Parts 64
Calendar of Meetings 78
Manufacturers Publications 83
Business Announcements 85
Cross Sections 86
Topics 22

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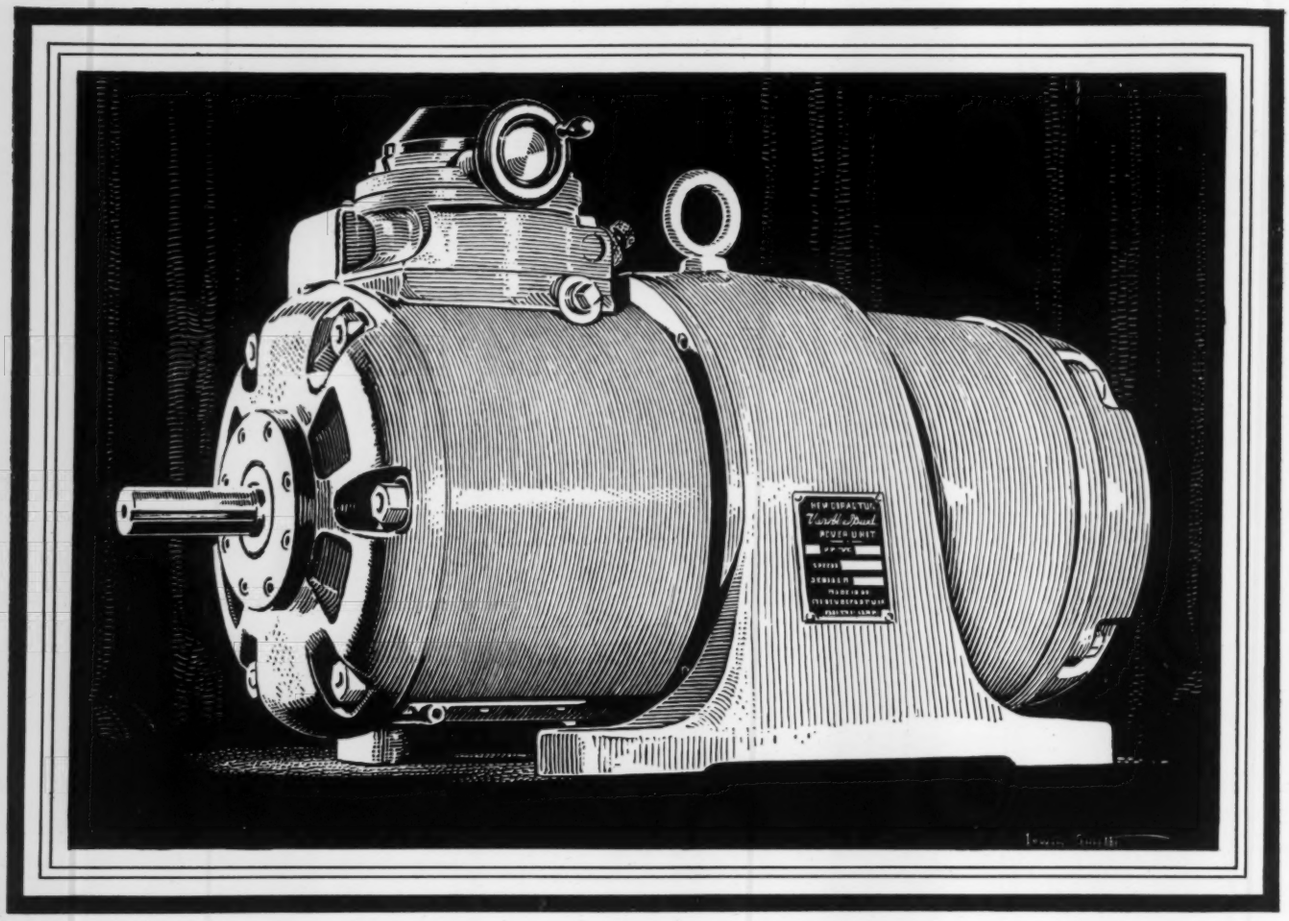

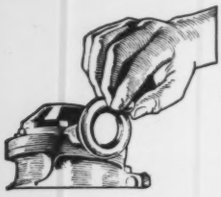

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Itemized Index

CLASSIFIED FOR CONVENIENCE WHEN STUDYING SPECIFIC DESIGN PROBLEMS

Design Calculations:

Plain bearings, Edit. 37, 38, 39, 81L

Design Problems:

Abrasion, resisting, Edit. 40, 41R, 42L

Bearings, specifying plain, Edit. 37, 38, 39, 81L

Centrifugal force, utilizing, Edit. 25, 26, 27

Developments, determining action of, Edit. 28R, 29

Lights, building in, Edit. 49

Materials, utilizing special, Edit. 40, 41, 42, 43

Pumps, applying air, Edit. 31, 32, 33, 82R

Safety insuring, Edit. 29

Springs, specifying, Edit. 49R, 50, 51L

Vibration, combatting, Edit. 34, 35, 36, 43, 79L

Finishes:

Paints, Edit. 44; Adv. 81R

Primers, Edit. 75L

Materials:

Alloys (Hard-Facing), Edit. 42L

Alloys (Nickel), Edit. 40R, 43L; Adv. 55

Alloys ((Steel), Edit. 40R, 42, 43L

Aluminum, Edit. 42

Brass, Edit. 43L

Bronze, Edit. 37R, 42R

Copper, Edit. 40R

Cork, Edit. 43R

Felt, Edit. 27L, 34, 35, 36, 79L; Adv. 59, 84L

Iron, Edit. 41R

Molybdenum, Adv. 13

Plastics, Edit. 37R, 56, 74R; Adv. 78L

Rubber, Edit. 27L, 29, 43R

Steel, Adv. 15

Mechanisms:

Alarm, Edit. 60R, 62R

Driving, Edit. 28, 58R

Printing, Edit. 56, 58R

Organization and Equipment:

Engineering department, Adv. 14, 60L, 72L

Parts:

Bearings, Edit. 26R, 27L, 37, 38, 39, 58R, 60R, 68R, 70R, 81L; Adv. 8, 53, 57, 61, 62L, 75R, 78L, 86L, 92

Cast parts, Edit. 26R, 41R, 42R

Clutches, Adv. 74L, 82L

Controllers, Edit. 77L

Controls (Electrical), Edit. 72R, 74R; Adv. 2, 10, 11, 64L, 69, 90

Conveyors, Edit. 26R, 27

Counters, Adv. 24, 64L

Couplings, Edit. 66R, 68R

Drives, Edit. 27, 58R, 64R, 66R; Adv. 3, 6, 9, 18, 23, 71, 72L, 77R

Fastenings Edit. 76R, 77L; Adv. 88L, 91

Gears, Edit. 28; Adv. 20, 65

Instruments, Edit. 30

Lights, Edit. 49, 75L, 76R

Lubrication and lubricating equipment, Edit. 26R, 37, 38, 39, 70R, 72R 81L; Adv. 66L, 87

Motors (see also under drives), Edit. 66R; Adv. 17, 58L, 67, 68L, 73, 80L, 83R, 85R

Packing glands and packing, Edit. 26R, 27L; Adv. 4, 16, 21, 74L, 82L

Plugs (Electrical), Adv. 12

Pumps, Edit. 31, 32, 33, 74R, 75L, 82R; Adv. 76L, 80L, 84L, 88L

Shapes, Adv. 79R

Springs, Edit. 49R, 50, 51L, 60R, 62R; Adv. 76L

Welded Parts and equipment, Edit. 29R, 30L; Adv. 19

Wheels, Edit. 76R

Principles:

Centrifugal, Edit. 25, 26, 27

Sales and Sales Department:

Finishes, importance of, Edit. 44

Key: Edit., Editorial Pages; Adv., Advertising Pages; R, Right hand column; L, Left hand column

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Topics . . .

PERHAPS the greatest international event of mechanical significance in recent weeks was the launching of the German dirigible LZ129, named the VON HINDENBURG. Dr. Hugo Eckener, its chief designer, went aloft with it on the maiden flight over Lake Constance.

The new craft is forty feet longer than the GRAF ZEPPELIN and has a capacity of 7,000,000 cubic feet of gas as against the GRAF'S 2,708,000. Instead of twenty passengers she accommodates fifty. While the GRAF has five Maybach internal combustion gasoline engines delivering a total of 3000 horsepower, the new ship has four 1200 horsepower engines built on the diesel principle, burning crude oil. A car fastened to the hull of the GRAF carries the passengers, while in the LZ129 they travel in the hull itself.

♦ ♦ ♦

That much for Germany's progress . . . . what is to be the future program of lighter-than-air development in this country? A board of scientists appointed at the request of Secretary Swanson and headed by Prof. William F. Durand of Leland Stanford university has spent ten months of intensive study on this question. They now have reached the conclusion that the navy should not scrap its airship development program. Building of ships as large or larger than the ill-fated AKRON or MACON is perfectly practical, they report, and commercial transport, despite the advance made with the airplane, cannot afford to shut out aircraft at this stage.

♦ ♦ ♦

Brisk business in the machine tool industry always is a favorable indication. Some good orders have been booked such as for instance the thirty-five boring mills placed by Amtorg Trading Corp. with a Cincinnati manufacturer. And speaking of machine tools, it is interesting to note that W. E. Whipp, president of Monarch, is attaching a plate to each lathe showing its cost. This is being done to arouse in the workman respect for his machine and to encourage him to do better work with it.

♦ ♦ ♦

William B. Stout has done it again. This time it's a movable home to be drawn behind an auto. In transit the unit is 16 feet long and 6½ feet wide, but when the motorist is ready to occupy it the mobile structure folds out into a living room 20 feet across and 14 feet long, supplemented by a kitchen.

♦ ♦ ♦

It looks feasible to E. F. Lougee, editor of *Modern Plastics,* to make a complete auto body panel molding in one piece so that a door panel would not only include the lining but also the window molding. Seems as though the possibilities of these plastics are endless.

♦ ♦ ♦

Russia now is talking about steam-propelled airplanes. The idea was popular in this country several years ago when the Besler brothers built and flew a steam-driven plane in California (M. D. Jan., 1934).

♦ ♦ ♦

M.I.T. finds the demand for men educated in engineering and science rapidly increasing. Of the class of 578 graduated last June fewer than six per cent now are available for employment.

♦ ♦ ♦

Thirty McMullen regional scholarships will be awarded at Cornell in September to aid young men in obtaining an engineering education. This doubles the present number of scholarships.

♦ ♦ ♦

Out of the contest waged by large newspaper and picture interests for rapid electrical transmission of news photographs

(*Concluded on Page* 80)

MACHINE DESIGN

Centrifugal Force "Shoots" Abrasives

By Allen F. Clark

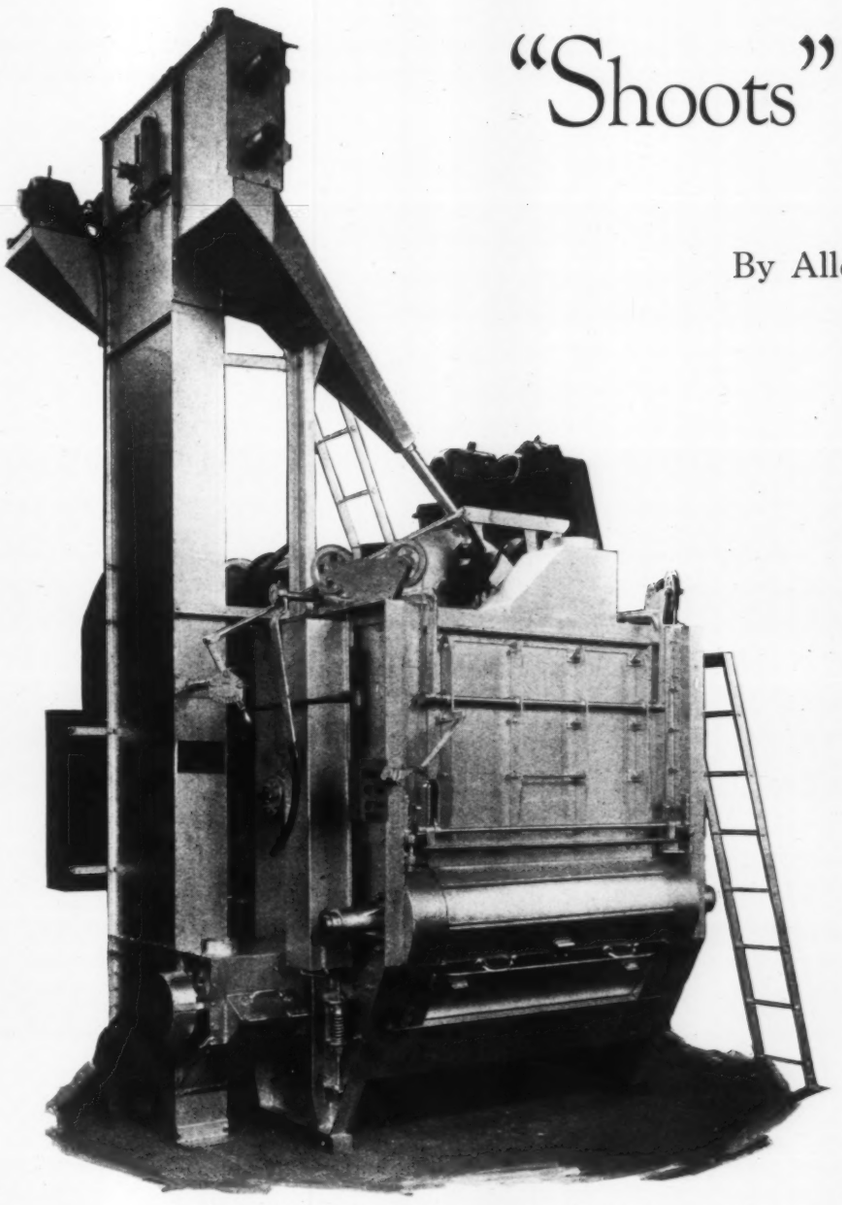

Fig. 1—Use of centrifugal force in a cleaning machine for metal parts simplifies equipment required

CENTRIFUGAL force is a natural phenomenon which, when properly adapted and controlled, can be of valuable assistance in the design of many types of machinery. An example of the application of this force is found in the Wheelabrator, a machine for abrasively cleaning metal parts without the use of air.

Considered from the design standpoint, the elimination of compressed air means the elimination of many pieces of equipment, including tanks, piping, hose, nozzles, valves, mixing chambers, etc. However, this is not the only saving introduced by the application of the principle of centrifugal force. This machine originated and built by the American Foundry Equipment Co., requires considerably less horsepower than ordinarily would be employed for the same work. Action of Wheelabrator Tum-Blast *Fig.* 1,

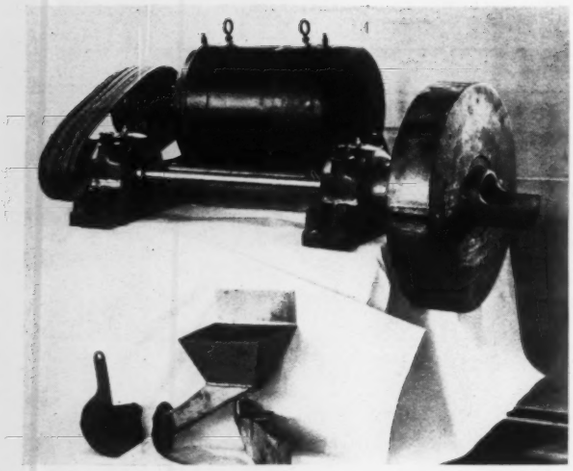

Fig. 2—This wheel for throwing the abrasive is the heart of the machine

is particularly simple. Abrasive suited to the work is fed by gravity into the center of a patented wheel shown at the right of *Fig.* 2, rotating at high speed. By centrifugal force the abrasive is thrown from the wheel upon the work being cleaned or surfaced. The design problem was not the securing of this action, but rather the control of the action. Directional control is imperative to secure proper distribution of the abrasive.

This directional control is secured by means of a patented cage which fits inside of the wheel. The cage, the end of which is shown at the right end of the shaft in *Fig.* 2, and is also shown in *Fig.* 3, confines the distribution of the abrasive

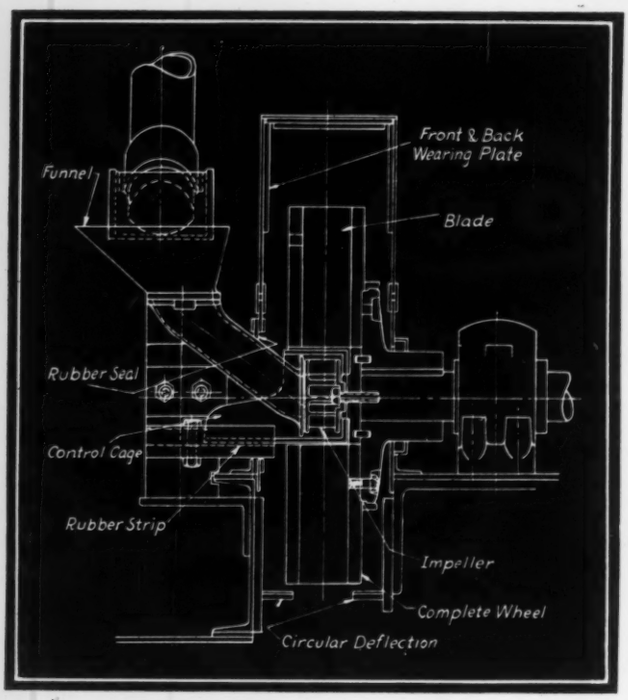

Fig. 3—A special cage confines the distribution of the abrasive to the area occupied by the work

to that section of the wheel from which it will be thrown over the area occupied by the work. Thus the abrasive is concentrated over a specific area. The area of concentration may be changed by the substitution of different cages.

Power for operating the impeller, *Fig.* 3, which actuates the abrasive, is obtained from a motor mounted on top of the machine, through multiple V-belts. This impeller is a cast alloy steel part which operates at 2250 revolutions per minute. The cage is also a cast part while the wheel itself is fabricated from special abrasive resisting steel stock.

Mounting of the wheel assembly is complicated only in that a special type of tapered roller bearing is required for efficient operation. All

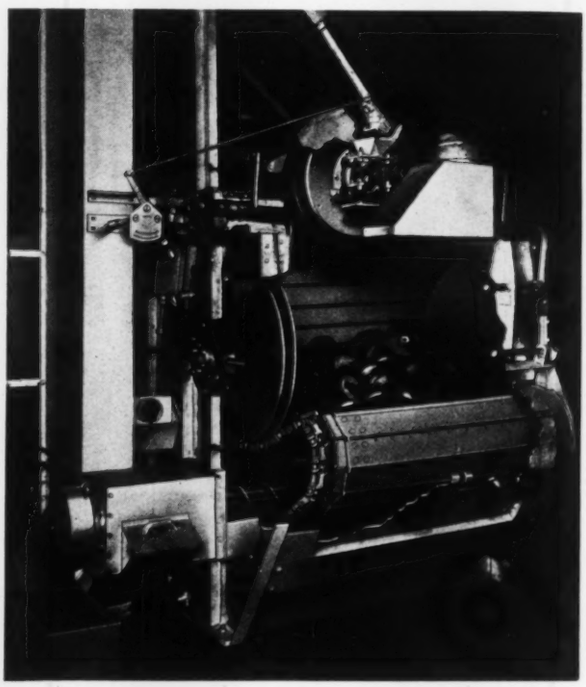

Fig. 4—Tumbling action produced by apron conveyor presents all parts to the cleaning force

seals are of the piston ring type. These are used in various combinations throughout the machine and, together with dust tight seals wherever possible, adequately protect the bearings from grit. Lubrication for the shaft bearings as well as all other bearings in the machine is by means of the single shot system, selected as the most practical for a machine of this type.

While the centrifugally-thrown abrasive will adequately clean all surfaces persented to it, it is impossible to throw the abrasive from all sides. The most practical method of securing complete cleaning, and the method selected for use in this machine, is to turn the castings or other metal parts continually as the abrasive is being thrown, thus presenting all surfaces to the abrasive and equalizing the action.

Turning action is secured by the unique con-

veyor assembly shown in *Fig.* 4. The conveyor is made up of individual links, a short section of right and left-hand chain and two links with a conveyor plate attached, *Fig.* 5. In the machine shown in *Fig.* 1 a steel link is used, while the links in the smaller machines are of malleable iron. A hardened steel roller is held in position in the link by a machined and hardened bushing which is locked in the link. A pin of hardened steel secured with a cotter holds the links together. The conveyor apron consists of overlapping steel plates of rolled section, with holes drilled for allowing the spent abrasive to drop through into the return conveying system.

Stresses in the shafting for the conveyor sprockets are reduced by the use of a heavy center section turned down at the ends for bearings and sprockets which are of special tooth formation. As might be expected, especial care is required to protect the roller bearings used on these sprockets from dust and grit. To secure

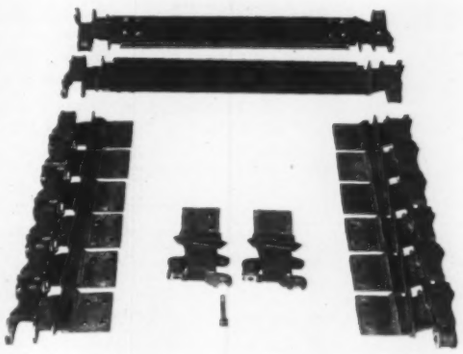

Fig. 5—*Conveyor is made up of individual links, chain, and special plates*

this protection, extensive use has been made of felt seals and rubber washers. A cross section of the sprocket mounting is shown in *Fig.* 6. Drive for this conveyor is secured from a motorized reducer mounted on the top of the machine through a flat belt. This type of transmission was selected to secure a safety factor for the machine in the event that parts being cleaned might stall the conveyor.

The shape of the interior chamber is not that of a complete barrel although the conveyor flights travel around two barrel heads. It is this shape, which provides the necessary tumbling action. A tumbling rather than a rolling action is necessary for perfect cleaning of all of the surfaces. A take-up sprocket at the rear of the machine permits correct adjustment of the conveyor without disturbing shape of the chamber.

The interior heads, *Fig.* 7, form an internal track and are designed to permit the conveyor apron to ride around them, retaining a dust-tight chamber. Bearings are of the tapered roller type, designed for heavy duty and mounted in dust-tight housings.

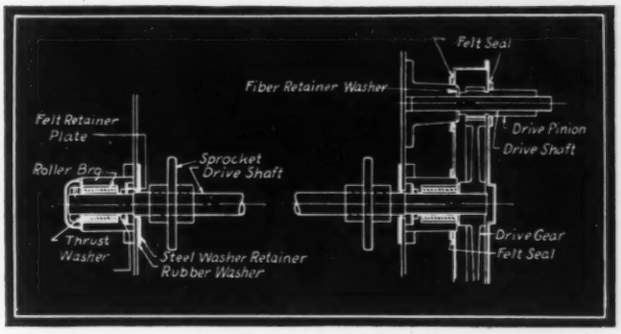

Fig. 6—*Especial care is required to protect the roller bearings from the abrasive*

The only additional mechanisms in the machine are the parts designed for control of the abrasive material. This material, as before noted, falls by gravity into the center of the wheel. Here it is thrown on to the work. Next the material falls through the holes in the conveyor flights into a chamber through which runs a screw conveyor. The conveyor is made of a special steel selected for its abrasive resistance. A rotary screen used in connection with this rotor separates the foreign material from the spent abrasive before the abrasive is recirculated. A bucket-type elevator lifts the abrasive again to the top of the machine.

Thus with a few simple mechanisms it has been possible to construct a machine for cleaning or preparing the surface of metal parts which gives a completely efficient action, yet requires few parts and less expense than units offered previously. This type of equipment fulfills the true purpose of careful mechanical design — the development of simplified machinery which will do the job required accurately, efficiently and economically.

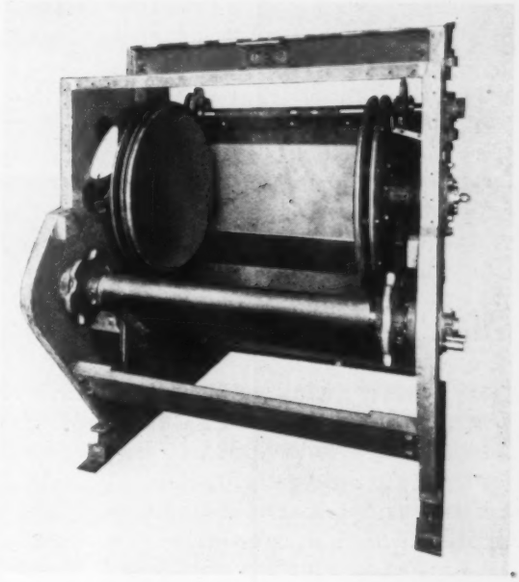

Fig. 7—*Interior heads form an internal track around which conveyor rides*

Scanning the Field . . . FOR IDEAS

ROLLERS EFFECT REDUCTION DRIVE

TRANSFERENCE of ideas, the life of mechanical progress, could not be better illustrated than by the nonreversing positive gear reduction shown in *Fig.* 1. Finding practical application on a well-known domestic can sealer, the device has been adapted to a drum hoist.

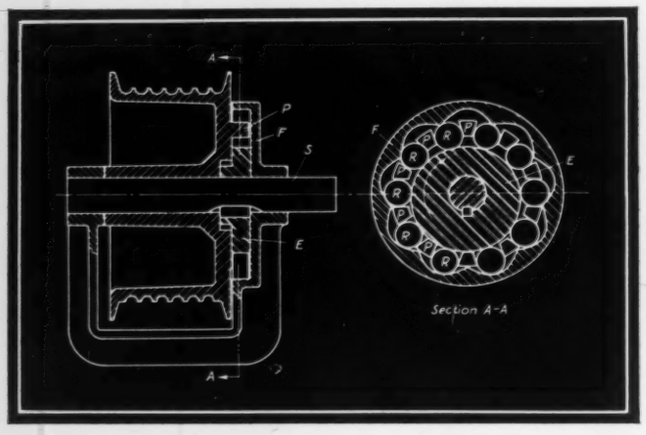

Fig. 1—*Ratio of reduction drive depends on number of rollers, which is one more than number of lobes*

Driving shaft *S* is keyed to eccentric *E*, which when revolving clockwise urges rollers *P* down the inclines of the lobes machined in frame *F*. The rollers in turn drive projections *P* of the drum and therefore the drum itself, in a clockwise direction.

All rollers marked *R* are working, while the other rollers are idle, being pushed up the inclines on the opposite side by the idle drum projections. The working rollers always are on the leading side of the eccentric. Ratio is determined by the number of rollers, which is one more than the number of lobes.

The gear is symmetrical and can be driven in either direction but, similarly to a worm gear, it will not reverse under load when the driving force is removed. Designed by Clifford E. Ives, 2400 W. Madison St., Chicago, the mechanism is adaptable to elevators, steering mechanisms, etc., where it is desirable to lock the driven member against the action of all forces other than that of the driver.

HIGH SPEED CAMERA DETECTS FLAWS

MODERN engineering department equipment such as the high speed motion picture camera is rapidly eliminating archaic cut and try methods in design. (See M.D., March, 1935). Time is lost and money wasted in guess work when the engineer attempts to correct maloperation of mechanisms by redesigning first this and then that member. The alert designer utilizes such apparatus as that recently developed by General Radio Co., Cambridge A, Mass., this consisting of the Edgerton power stroboscope and the type 651-A camera.

Motion pictures taken at the rate of 1000 or

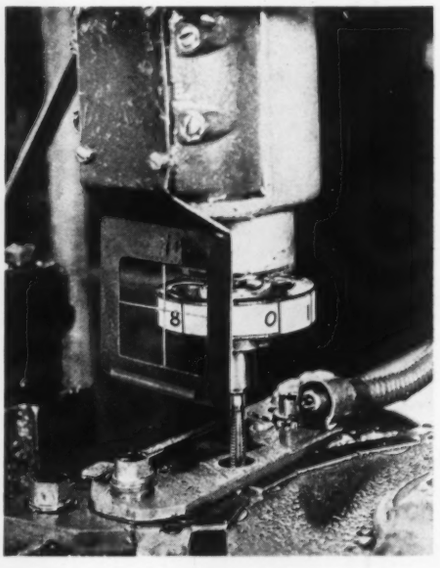

Fig. 2 — *Setup employed in studying operation of automatic tapping machine with high speed motion picture camera*

more per second and projected at normal speeds in the vicinity of sixteen per second give an accurate slow-motion view of the high speed operation. In solving specific problems projection is sometimes supplemented or replaced by a graphical analysis of the film record.

An interesting example of the use of this equipment in the mechanical field is shown in *Fig.* 2. In redesigning an automatic tapping machine, it was necessary to know the speed characteristics throughout the entire cycle of operation. A drum, numbered in sections, was attached to the spindle of the machine. This was supplemented by an aperture equipped with cross hairs, and interposed between the revolving drum and the camera. Thus it was possible to analyze the pictures made by the camera by measurement of the angular displacement for each frame of the motion picture film.

From the data yielded by the film a curve was plotted showing precisely how the machine performed over a period of one complete cycle of operation, making it possible for the designers to see clearly each irregularity and the exact time at which it occurred. Compensation by means of cams then was provided to attain smooth and accurate performance.

The stroboscope and the camera employed in this setup are unique. Since the film moves through the camera continuously without shutters, distribution of exposures on the film is determined by the rate of flash of the stroboscope light in relation to film speed. Apparatus used in industrial problems discussed in the foregoing is capable of taking pictures up to about 1500 per second and will illuminate an area about one foot square to a sufficiently high intensity to take satisfactory photographs on high speed film with an f/1.5 lens. Maximum speed is in the vicinity of 2000 per second, although pictures have been made experimentally with similar apparatus at speeds as high as 5000 per second.

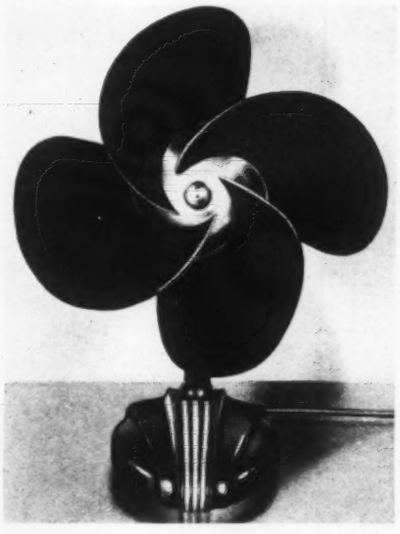

Fig. 3 — *Flexible fan blades of tough molded rubber are indicative of the possibilities that lie ahead for nonmetallic materials*

USE OF RUBBER ELIMINATES GUARDS

SUPPLEMENTING last month's profuse references to materials application, the electric fan design, *Fig.* 3, embodies another use for rubber. Safety stands out as one of the features of this innovation that employs flexible blades of tough, molded rubber. No guards are needed. Moreover, the Samson-United Corp., builders of the fan, say that it is noiseless. The motor is of new design also, remains cool in operation and is finished in gleaming brushed chromium. The designers have given particular attention to appearance in this notable achievement that gives rubber another new place in the design field.

While on the subject of materials, it is fitting to say more about the new type of glass air filters that were merely mentioned in the March number of MACHINE DESIGN. This Owens-Illinois development consists primarily of a series of bonded mats of flexible glass fibers confined on the intake and discharge faces by expanded metal grilles and enclosed by a fiber board frame. Applications include internal combustion engines, air compressors, warm air furnaces and ventilating units. It will pay designers to watch the progress of "glass wool" applications with a view toward its possibilities in other fields.

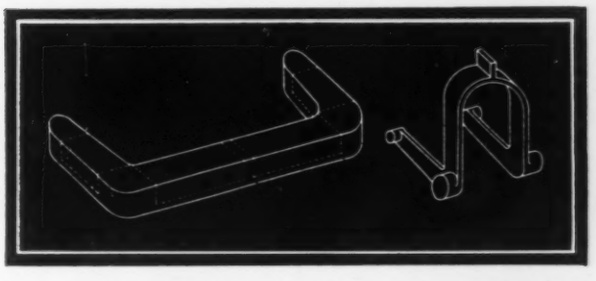

Fig. 4—*The locomotive reverse-lever arm at right was produced by flame cutting from a steel slab*

FLAME CUTTING SCORES AGAIN

NO ENTERPRISING engineer is overlooking the possibilities of flame cutting in designing for economical production. A concrete example of its far-reaching advantages is embodied in the fabrication of a locomotive reverse-lever arm, *Fig.* 4.

The parts are produced by a Linde oxyacetylene flame-cutting machine from steel slabs. After making the first cut in the usual way, the

machine was rearranged to simplify the second cuts. Dotted lines in the sketch at the left of Fig. 4 indicate the sections cut out in this subsequent operation.

The reverse-lever arm in its completed form is shown by the sketch at the right of the illustration. This is its shape after it has been bent and finish machined to the final tolerances and to round out the pads and other sections. Heating for bending also was done by use of the oxy-acetylene flame.

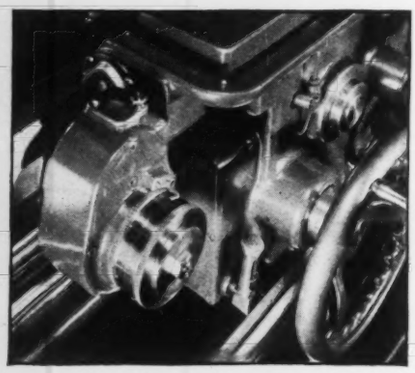

Fig. 5—Direct reading dial on a lathe gives the operator length of cut, thus eliminating necessity for stopping the machine to take measurements

In connection with the preliminary preparation of the steel it is interesting to note that the entire surface is sand blasted before any of the cuts are made. This precaution is taken to eliminate any particles of oxide from flaking off and thus interfering with the smoothness of the cutting operation.

THINK OF THE OPERATOR!

INDUSTRY is hungry for ideas — it needs more like the Monarch direct reading dials, *Fig.* 5, that obviate stopping a lathe to measure the length of a cut accurately, thus conserving the operator's time. Design thrives also on such simple but ingenious ideas as the new Kelvinator built-in thermometer, *Fig.* 7. Each of these devices is a further indication of the trend toward the building-in of units for improving efficiency and convenience.

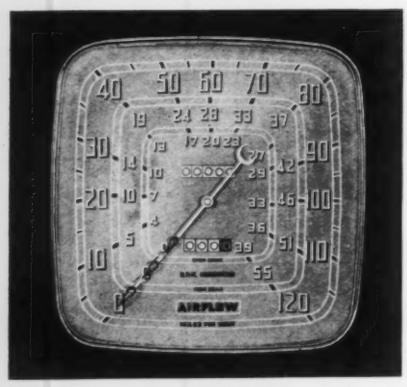

Fig. 6—Tachometer dial on autos equipped with automatic overdrive shows motorist how this innovation effects economical operation

The Monarch direct reading length dial mechanism is enclosed in a small oil-tight gear housing attached to the left or right-hand carriage wing of a lathe, replacing the carriage gib. A hardened pinion meshes with the bed rack, and through gearing in the housing one foot of carriage travel effects one complete revolution of the inner dial. One inch of carriage travel causes one complete revolution of the outer dial which is graduated to show sixty-fourths of an inch of travel. Both dials can be reset quickly to zero so that successive length measurements in turning or boring can be made quickly and read directly on the dials. On a lathe equipped with multiple automatic length feed stops the direct reading dials are found to be extremely convenient in setting the stop dogs.

The built-in thermometer on the Kelvinator refrigerator provides visible proof of the safely-cold food preservation temperature maintained in the food storage compartment. It is positioned in the side of the front baffle of the cooling unit *Fig.* 7., and is instantly visible. The bulb is located six inches below the defrosting dish in the center of the chamber where the average temperature is maintained most constantly.

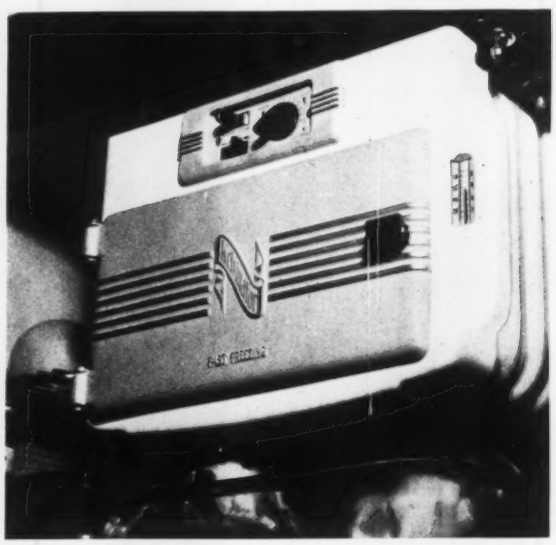

Fig. 7—A built-in thermometer reveals at a glance the temperature being maintained by a refrigerator

Another instrument, indicative of the designer's efforts to keep the operator apprised of operating conditions is the Chrysler tachometer dial, *Fig.* 6. It is installed on the instrument board of cars equipped with the automatic overdrive and serves as a constant reminder of the savings in fuel, oil and engine wear resulting from that innovation. An indicator points simultaneously to the speed in miles per hour, revolutions per minute in overdrive, and the corresponding revolutions per minute that would be reached in conventional drive.

Consider the Pump— Vital Factor in Machine Performance

Part I—Air Pumps

By Ormande Bogert

AIR—either pressure or suction—can often be substituted for mechanical means in the design of machinery to perform operations better, more smoothly and more economically. Application of this substance in design can be readily made by judicious use of pumps especially designed to create either the necessary air pressure or suction.

Considering first the pressure pumps, the type of blower for lowest pressure is the propeller type or office fan. This delivers a large volume of air at practically no pressure. It operates best when not connected to any piping. Next in the pressure range is the fan blower which is suitable for pressure up to about 6 ounces, top of *Fig.* 1. When greater pressure is required, the designer may use the turbine blower in which there is little clearance between the fan and the housing. This type is suitable for pressures up to about 3 pounds when made in multi-stage. It appears as in *Fig.* 1, top. Then comes the positive pressure blower which is suitable for pressures up to 20 pounds, while a few types are rated up to 50 pounds. Various designs of this type of unit are shown in *Figs.* 1, 2 and 3. For pressures above 20 pounds the reciprocating piston type should ordinarily be used.

Rotary positive pressure blowers of these various types which operate most efficiently at pressures between one and ten pounds have many uses in machines. By employment of a mechanism built around these pumps and included in a printing press, printed sheets can be sprayed with a mist of hot parafine to permit their being piled without smearing of the ink as they come from the press. The spraying is done with air at a few pounds pressure. Water can also be sprayed to increase the humidity of the atmosphere. Fuel oil can be sprayed and broken up

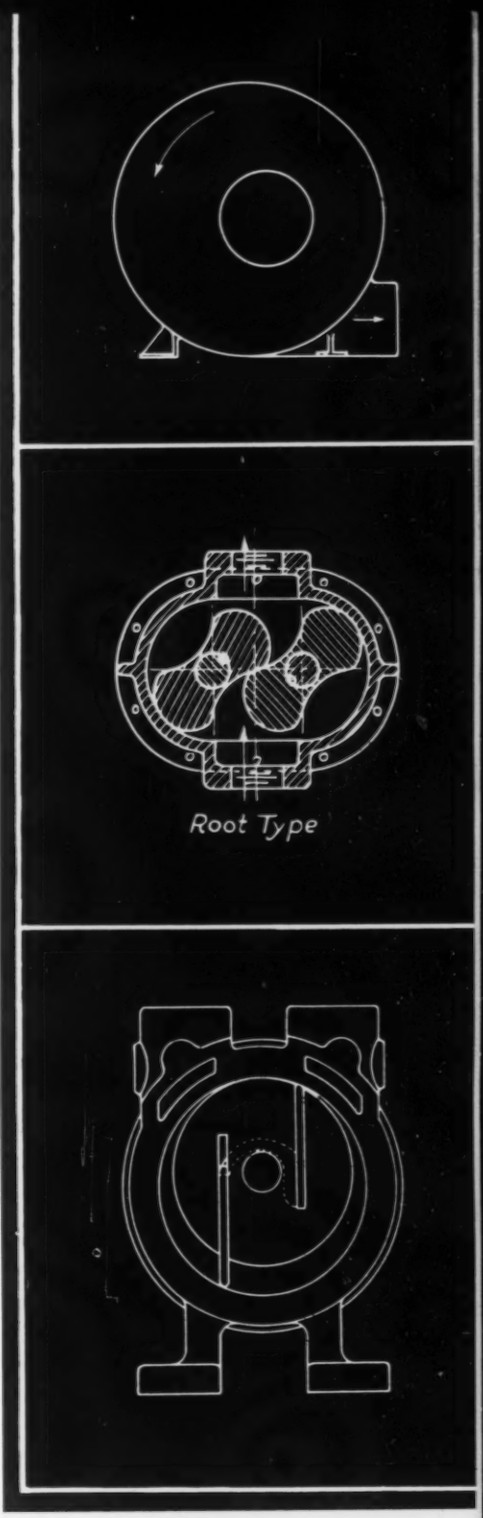

Fig. 2—Sliding portions of this pump compensate for any possible wear

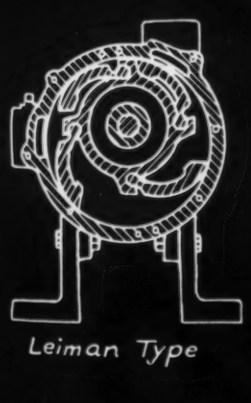

Fig. 1—A variety of means is employed for producing vacuum or suction

into a mist for firing boilers.

By boosting or increasing the city gas pressure with an air pump, the gas may be run through small tubing on machines to the point of consumption. Dust can be blown from inaccessible places on machines with air, and light punchings can be blown from the dies of presses. Low priced sand blasts can be operated with air at between 5 and 10 pounds pressure.

Another important application is the use of air at about five pounds pressure to float paper over the angle bars on continuous printing presses, especially rotogravure presses. In this machine the paper travels up to the angle bar,

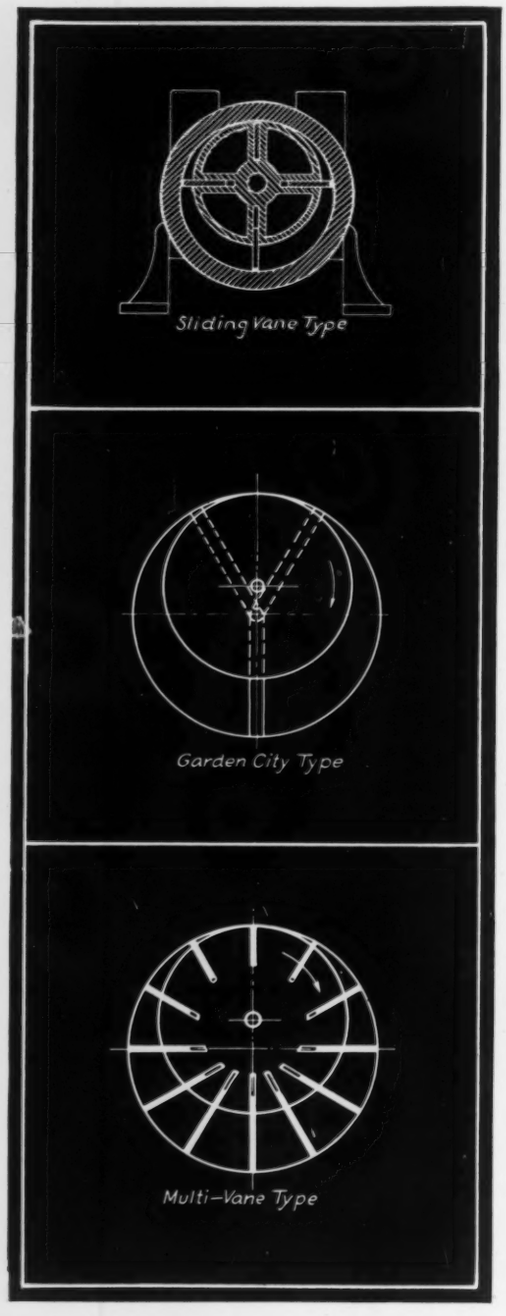

Fig. 3—Vane type pumps provide simplified means for providing air pressure

Fig. 4, around which it turns to go off at a 90-degree angle. The hollow angle bar in this application has a row of holes about ⅛-inch diameter drilled on about ¼-inch centers along the entire length covered by the paper. The air pressure is sufficient to float the paper and prevent it from contacting the bar and smearing the fresh ink.

Many of the pump designs described in the foregoing are used for suction or vacuum service as well as for pressure uses. Today's models have been designed to meet requirements for continuous operation under heavy duty. They are suitable for operation at speeds considerably higher than older type pumps, resulting in better volumetric efficiency, lower power consumption, and smaller space requirements.

One of the effective designs of these vacuum

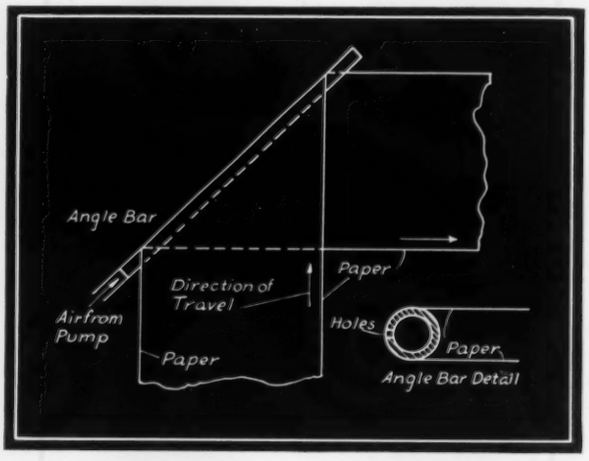

Fig. 4—Air pressure keeps freshly printed paper from smearing on the angle bar as it passes

pumps is the water sealed type in which the water is thrown by centrifugal force to the periphery of the impellers so that an effective seal is maintained even with comparatively large clearances.

Not all engineers are familiar with the many uses to which suction pumps may be put. One of the principal uses of vacuum is in the feeding of paper sheets from piles in connection with printing presses, paper folding machines, book binding machines and package wrapping machines. Hollow cone-shaped rubber suckers which are attached to the vacuum pump line are brought into contact with the upper sheet of the pile and, upon lifting take the sheet away with them. By blowing a light blast of air against the edge of the paper pile near its top, the top few sheets are floated on air separately and two sheets are thus prevented from being sucked up together.

This method is also applied to metal sheets. When lithographing tinplate sheets used in making tin cans, the sheets are picked up one at a time from a pile by vacuum suckers and

fed into the printing press. The metal sheets may also be picked up and fed into punch presses. It is difficult to handle and convey large, thin, polished metal sheets through a machine with mechanical means but with vacuum suckers it is an easy matter.

A cross section of a vacuum sucker is shown in *Fig.* 6. When the three-way valve connects the vacuum line from the pump with the line to the sucker, a vacuum is quickly built up in the sucker cup. If the sucker cup has an area of one square inch at the point where the sucker contacts the sheet, and if the vacuum is 20 inches (on a mercury column gage) then the suction lifting force will be approximately ten pounds. A vacuum of 10 inches would produce a lifting force of approximately 5 pounds. If more lifting force is necessary the area of the sucker cup should be increased or more suction cups should be used rather than increasing the vacuum.

On quick-operating feeders, such as those that feed about 60 to 100 per minute, the three-way

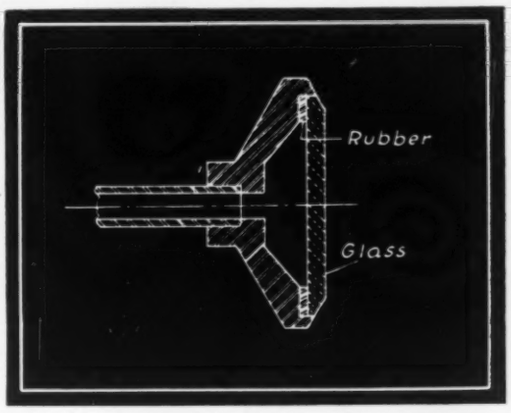

Fig. 5—*This vacum chuck is adapted to holding thin sections to be worked*

valve should be placed as near the sucker as possible and the tube leading to the sucker should be kept small (about ¼-inch) so as to keep down the air space which must be evacuated each time the valve opens to the vacuum line. When the valve opens to the atmosphere, the vacuum in the line to the sucker drops and the sheet is released.

Another type of paper feeder is the rotary feeder shown in *Fig.* 6*A*. The rotating rim which continually presents suction holes to the paper as the holes pass the suction duct in the stationary part, continually propels the paper forward.

Vacuum suckers are also used on bag and carton filling machines. Two suckers contact opposite sides of a closed bag, then withdraw and pull the bag open to allow filling. In the case of cartons, these are piled in the machine in the flattened form and suckers feed the cartons one at a time into the machine. Next,

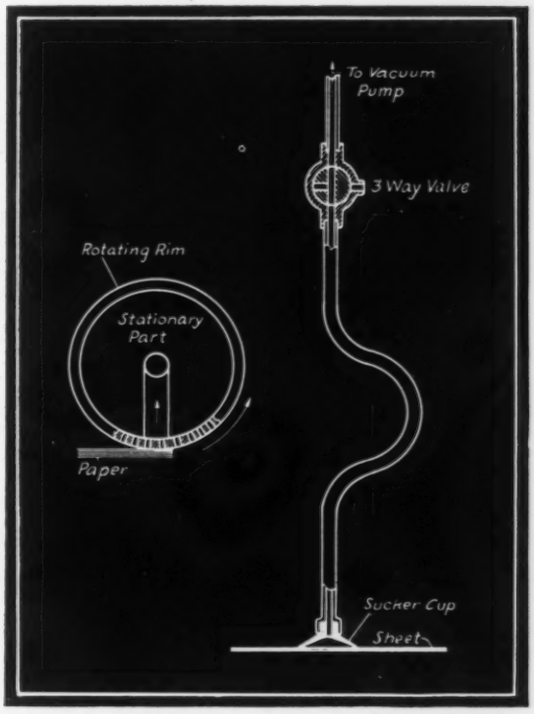

Fig. 6—*Suckers can be used to feed metal sheets in machines for lithographing*

two suckers contact the carton on opposite sides and open it. After the bottom flaps are mechanically folded in, the carton is filled.

Another interesting machine use of vacuum is the holding of light thin parts while they are ground or buffed. Parts too delicate to be held in a mechanical chuck can be held on a vacuum chuck. This chuck is made to suit the type of work being handled. It is recessed where possible for vacuum space, and the piece is held to the chuck face by vacuum. Some automobile hub caps are buffed in this manner. Circular pieces of glass are held in this way while having the edges beveled, *Fig.* 5.

Machines for mixing dry materials with liquids, as for example, whiting and linseed oil to make putty, are materially benefited by the inclusion of a vacuum in the chamber as this vacuum greatly speeds up the operation. The vacuum mixing also gives a better product as this method prevents any minute air bubbles from being entrapped in the mixture. Other processes are also carried on in machine tanks in which a vacuum is maintained in order to keep air bubbles from being entrapped in the material. This is particularly necessary preparatory to molding certain gummy materials such as printing press rollers.

When applying presssure blowers or vacuum pumps, the designer should always provide a vacuum relief valve on the vacuum pump line and a pressure relief valve on the pressure blower line. Main pipes should be the same size as the pump connections. Branch pipes can, of

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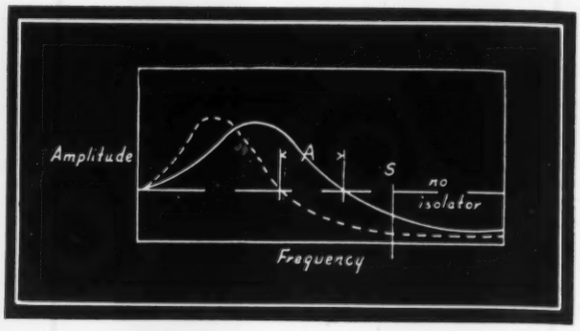


Fig. 1—As loading on the isolator is increased, the resonant point is shifted toward the lower frequencies

Isolate Vibration—

If It Must Be Present

VIBRATION isolators have two main characteristics—their elastic and damping properties. The first of these is called compliance and the second resistance. *Compliance* is expressed as the amount of deflection in feet for a load of 1 pound per square inch on a 1-inch thick specimen. (For springs it is the deflection in inches for a 1-pound load.) *Resistance* is a more complex term and is dependent upon the rate at which free vibrations are damped.

Tests made by Barss, Knobel & Young Inc., on felt isolators manufactured by Felters Co. Inc., show that if a machine is placed upon an isolator and measurements taken over a range of frequencies of transmitted amplitudes, a curve similar to the solid line of *Fig.* 1 is obtained. If the loading on the isolator is increased, then the resonant point is shifted toward the lower frequencies as shown by the dotted line. This is advantageous since the isolator becomes efficient over a greater range of frequencies designated by *A* and its efficiency has been increased at any speed such as *S* in the range where the isolator is actually effective.

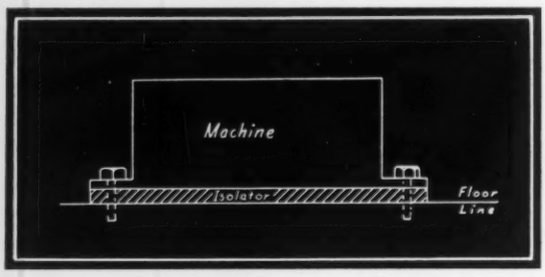
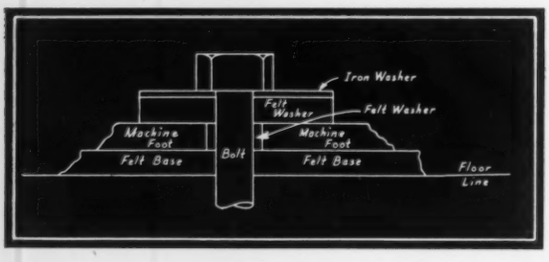


Fig. 2—This type of installation is valueless as bolts bridge the isolator

Fig. 3—Felt washer prevents the bolt from touching the machine foot



Possible Loading Limited

Further increase in loading will result in theoretically improved performance. Practically, however, there is a limit to which loading can be carried. This is determined by the strength of the material and its ability to withstand slow settlement and the gradual loss of its elastic properties. (Change in its compliance and resistance values.)

Care must be taken in the application of an isolator to see that no path is available for the vibrations to be transmitted other than through the isolator. If such other path is present, the isolator is said to be "bridged." For example, the installation shown in *Fig.* 2 is valueless. The holding down bolts bridge the isolator and vibrations are as readily transmitted to the floor as if no isolator were present. This is a difficulty which must be considered with all machines which require fastening to a foundation.

The general scheme to overcome bridging is shown in *Fig.* 3. The top felt washer supports

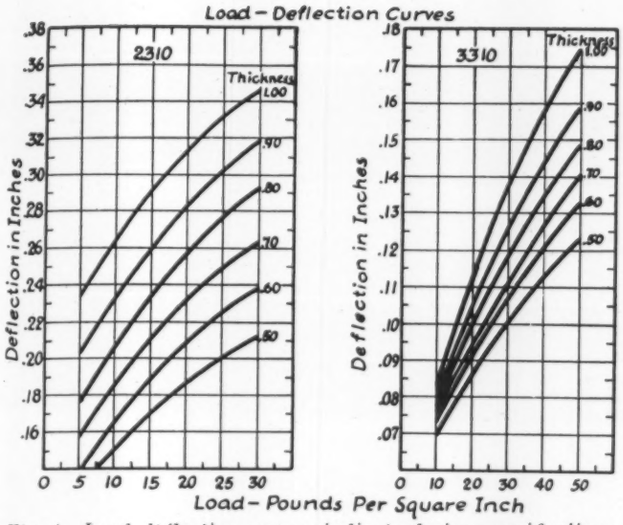


Fig. 4—Load deflection curves indicate design specifications for two kinds of felt

the bolt load. The center felt washer is used as a spacer and prevents the bolt from touching the machine foot. This should be a loose fit on the bolt. The felt base pad supports the machine plus the bolt load. Vibrations cannot reach the floor except by being transmitted through the isolator and no bridging results.

Laboratory and field tests indicate that felt is well adapted as an isolation material for heavy loads. In the majority of heavy machines the area of the footings is comparatively small so that the use of some isolation materials requires a change in the size of footing or an additional thickness of material. Heavy machinery offers the best opportunity for the use of felt as an isolator.

Describes Types of Felt

The field of heavy loading ranges from 10 to 50 pounds per square inch. For the purpose of loadings of this size, felt materials known as 2310, or Type B, and 3310, which we will call Type A, in various thicknesses have been found most desirable. Material of Type A is what is known as an all wool back check. It weighs approximately 7¼ pounds per 60-inch yard for ¼-inch thickness, is grey, and has a 100 per cent wool content. Material of Type B is known as an all-wool firm pad, 5¼ pounds 72-inch yard, is grey, and has 100 per cent wool content. The load deflection curves for these two felts are shown in *Fig.* 4.

From experiments in loading the felt over an appreciable time and then measuring the "permanent set" of the material, it has been found that if Type B is loaded to 30 pounds per square inch, its permanent set is not more than 6 per cent of its original thickness. For Type A loaded to 50 pounds per square inch, the set is approximately 5 per cent of its original thickness.

The compliance figures (measure of elasticity) start to decrease rapidly for Type B at 30 pounds per square inch, and for Type A at 50 pounds per square inch. The best selection of load ranges is that Type B should be used in the range from 10 to 25 pounds per square inch, and Type A for loads above 25 pounds per square inch and up to 50 pounds per square inch. Special types of felt have been used in marine work at loadings of 375 pounds per square inch with success under these extremely severe operating conditions. Felts are available where loadings can be in excess of 1000 pounds per square inch.

Isolation will be improved with the thickness of the isolating material. For example, for isolating a machine with a load on the footings of 40 pounds per square inch, better isolation will be obtained with 1-inch Type A felt than with ½-inch felt of Type A. It is not true, however, that the 1-inch felt will be twice as good as the ½-inch felt.

We have then reached the following conclusions:

1. Use Type B—1-inch felt for loadings up to 25 pounds per square inch.
2. Use Type A—1-inch felt for loadings in excess of 25 pounds per square inch.
3. In cases where other considerations

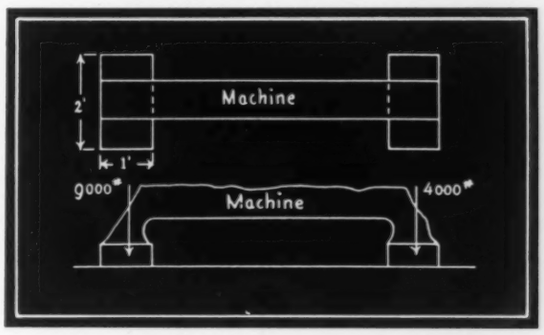
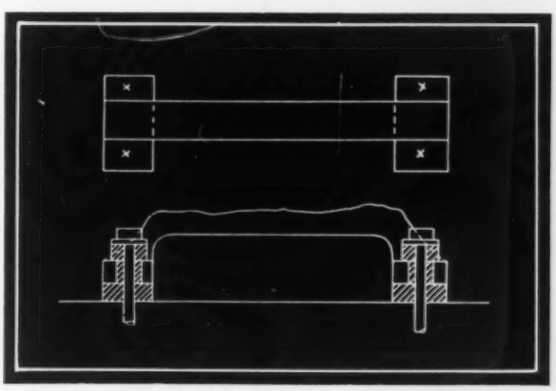


Fig. 5—Unequal loading on supports necessitates different types of isolation

Fig. 6—Isolator supports machine load plus the load of the bolts



make the use of 1-inch material impossible, a smaller thickness than 1 inch can be used, but not less than ½ inch.

It frequently happens that the supports of a machine are unequally loaded. In such case the size of the isolator should be adjusted so that equal deflections are obtained at each support. A typical example will illustrate the procedure in such cases. In *Fig.* 5 the two machine supports are of the same area, the load on the left support being 9000 pounds and the load on the right, 4000 pounds. The cross-sectional area of each support is 288 square inches. It is assumed that no holding down bolts are required The loads per square inch on the supports are: Left support—31 pounds per square inch; right support—14 pounds per square inch.

Deflections Are Equalized

Under the left support we shall use Type A—1-inch thick of 288 square inches area. The deflection of the felt will be 0.142 inches under the load. If 288 square inches of this material were used under the right support, the deflection would be 0.095 inches. In order to make the deflection on the right support the same as on the left, we can decrease the cross-sectional area of the felt on the right so as to get the same loading (of 31 pounds per square inch), as on the left. The area of felt to use under the right support is 4000/31=130 square inches.

Assume that in the previous problem four holding down bolts are required. These are located as shown in *Fig.* 6. The force exerted by

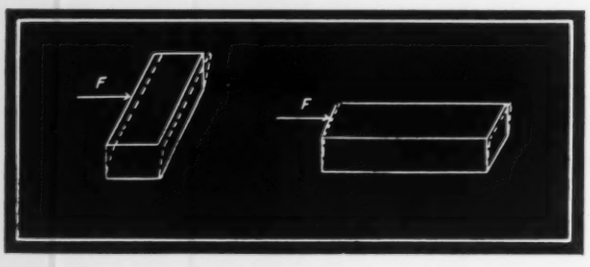


Fig. 7—Deflection of isolating material may be decreased by location

each bolt will be approximately 1500 pounds. Considering the left support, the total load on the 288 square inches of isolation will be 9000+3000=12,000 pounds, giving a load of 42 pounds per square inch. (Note that the isolator under the machine supports the load of the machine plus the bolt load.)

As stated previously, bridging is avoided by the use of felt under the bolt head and a felt washer between the bolt and the machine foot. The bolt load is 1500 pounds and at 42 pounds per square inch, the necessary area of 1-inch—Type A felt is 1500/42=36 square inches. This can be in the form of a washer 6¾ inches diameter. When the bolt is screwed down this felt washer should be squeezed down 0.16 inch from its original 1-inch thickness.

Consider now the right support. The two bolt loads are each 1500 pounds. The load on the supporting isolation is 4000+3000=7000 pounds. Since the same loading (42) is desired on the right support as on the left, the area of Type A—1-inch felt under the right support should be 7000/42=167 square inches. The

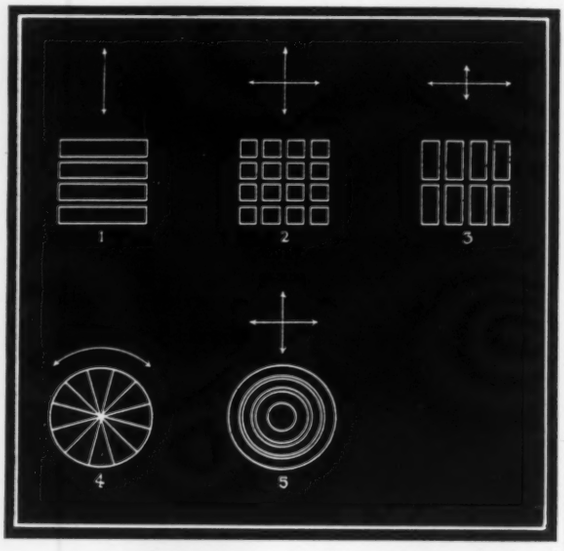


Fig. 8—Patented methods of arranging material satisfy the majority of cases

washers under the bolt heads will be 6¾ inches diameter, the same as for the left holding down bolts.

It has been found that the vibrations of a machine or part in one horizontal plane are generally large compared to those in another horizontal plane at right angles to the first. It is obvious that the material which is used as an isolator should be capable of reducing the horizontal vibrations in both planes in order to be considered efficient. In order to do so, the isolator should have greater resilience in the direction of the larger vibration.

A simple means of accomplishing this result is to divide the total area of isolator into a number of rectangular strips, the long dimension of the strips being at right angles to the maximum horizontal vibration.

Base Arrangements Presented

For example, if the isolation pad is cut in a strip as shown in *Fig. 7A,* and a total force *F* is applied to bend the strip (the base being fixed), it deflects a certain amount as shown by the dotted lines. If now the force *F* is applied as shown in *Fig. 7B,* the deflection of the material is much less. In the first case we have more

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Checking Theory with Tests in Bearing Design

L. M. Tichvinsky

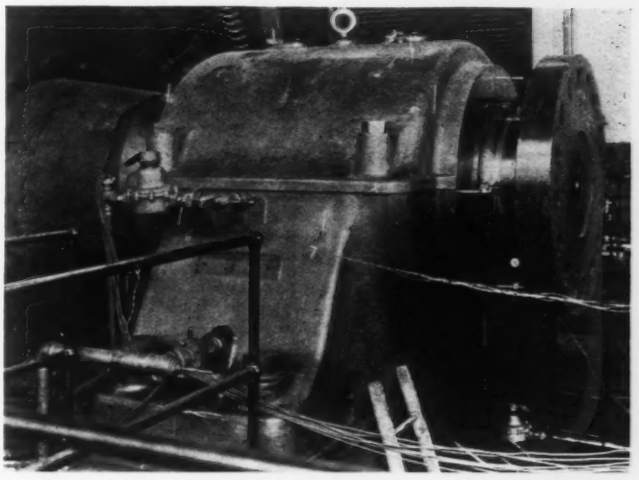
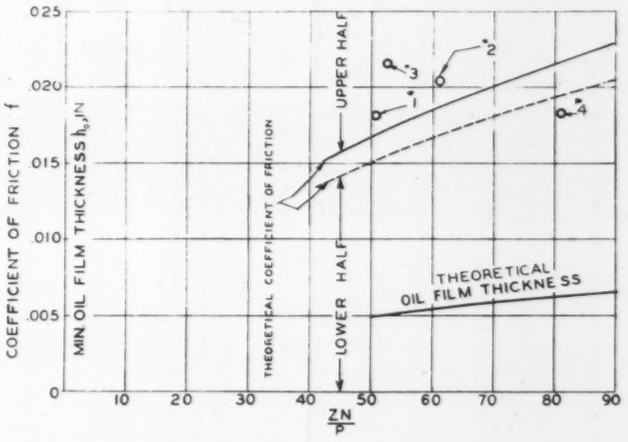


Fig. 1—Above—Field test setup for 30 by 60-inch bearing showing oil flow meters, thermometer, thermocouples, dial gages and wiring for heating the oil

Fig. 2—Below—Results obtained in the above test and comparison with calculated values of the coefficient of friction. Total load acting on bearing was 257,500 pounds



PRESENT practice has shown that a satisfactory criterion for bearing design is offered by the so-called characteristic number, ZN/P, Z being the viscosity of lubricant in centipoises; N the revolutions per minute; P the pressure in pounds per square inch. This value is usually given graphically in conjunction with the value of the coefficient of friction; the former is plotted as abscissa and the latter as ordinate. It is immediately evident that such charts or curves contain the most important variables involved in bearing design; namely, coefficient of friction, pressure, speed, and viscosity-temperature of the lubricant.

A large scale of such a chart will reveal at once the dangerous region in the low values of ZN/P. Preliminary calculation of the value of ZN/P, making a reasonable assumption of temperature viscosity, will indicate whether or not the bearing is performing close to the danger point. At the present time all designers of bearings first consider these charts on which the theoretical values are plotted, and then, during tests of actual machines, or when the opportunity arises, experimental points are found and plotted to show the deviation from the expected performance. These curves are known as "bearing performance curves".

Materials for Small Bearings

White metal-lead base and tin base sleeve-type, and antifriction bearings, are widely used in the small bearing group, particularly for electric motors. The sleeve type usually is fitted, though sometimes relieved on the sides. Waste-packed bearings are also in use for small motors.

In regard to improvement in the performance, not much is being done on small size bearings. As well as from such metals as hard and soft bronzes, small bearings are constructed from special materials such as so-called graphitized bronze, Compo material, Coprex alloyed bronze.

Micarta, a nonmetallic product obtained by application of high pressure and temperature to Bakelite impregnated cloth, also proved to be an excellent material for this group of bearings. Small sleeve bearings of this material are

used extensively in textile mills (sleeve bearings and spindle bushings, oil lubricated for high speed), in farm machinery (sleeve bearings, imperfect lubrication — grease — low speed), in home appliance machinery, etc.

Wooden bearings, such as Woodex, have been successfuily used in many applications. Only

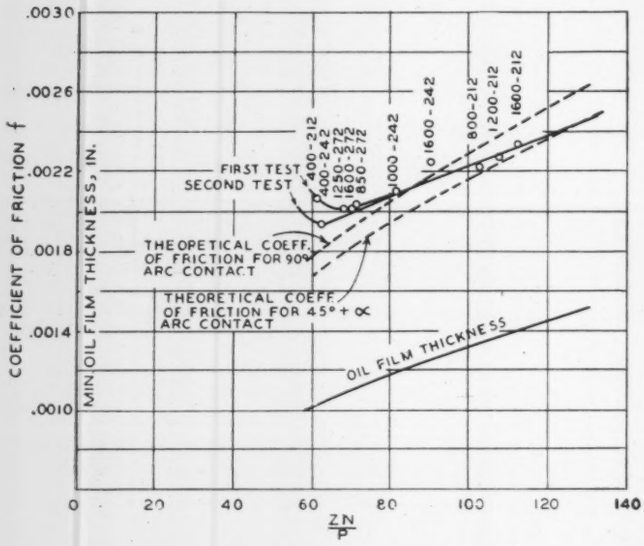


Fig. 3—Test results in which the tendency of the value of the coefficient of friction to go up with the lowering of value ZN/P can be seen clearly. A 6 by 12-inch journal bearing was used

best grades of maple wood are subjected to special processes which extract all the sap and water from the fibers and replace them with a lubricant.

Power Bearings Are Discussed

Power bearings form an integral part of heavy machinery such as alternating and direct current motors and generators, frequency changers, condensers and turbines, all of which range in power from a few hundred to more than 100,000 horsepower. In designing such bearings the theoretical performance is first found and then a few performance points are checked on the actual machine. To find the performance of a bearing it is necessary to have the following data: The value of the coefficient of friction, oil flow, thickness of the oil film at the point of nearest approach, temperature of the oil film and the temperature rise of the bearing above that of the ambient air. These data enable the engineer to calculate the bearing losses and the amount of oil necessary for maintaining the required oil film and for efficiently cooling the bearing. In addition, these performance data disclose the stability of the oil film in the operation of the bearing.

Bearing design is based on the hydrodynamic theory of lubrication, which goes back about fifty years and was developed by Petroff and Osborne Reynolds. They showed that in the case of perfect film lubrication the losses are produced by internal friction due to viscous or shearing forces in the lubricating oil. Petroff investigated a full journal bearing having a uniform clearance all around the circumference. Thus the situation is similar to that of a guide bearing without radial loading in which the journal runs concentrically with the shell.

The well known Newton expression for the frictional force reads:

$$F = \mu A (v/h)$$

where

F = total frictional force, lb.
μ = viscosity, lb. sec. per in. sq.
A = contact area, in. sq.
v = peripheral velocity, in. per sec.
h = clearance, in.

For A we can substitute πDL, the area of a bearing having D for diameter and L for length. The peripheral velocity may be written, $v = \pi DN$ where N is the number of revolutions per unit time. The clearance h equals $C/2$ where C is the total clearance between the shell diameter and journal diameter. Inserting these values into the expression for the frictional force,

$$F = 2\pi^2 (D/C)(L/D)\mu N D^2$$

The formula is written in the conventional bearing practice form where L/D and C/D are dimensionless ratios.

When bearings support large loads the picture becomes somewhat different. In this case, since the rotating journal is not concentric with the bearing shell, the oil adhering to the journal is forced into the wedge shaped clearance where the pressure is built up to such a magnitude as to resist the pressure resulting from the load. Here Reynolds expressed the friction force at any point of the moving surface, in terms of the pressure gradient in the direction of motion.

$$F = A\left[\frac{\mu U}{h} + \frac{h}{2}\left(\frac{dp}{dx}\right)\right]$$

where

U = relative velocity of the surfaces
h = oil film thickness
p = pressure
A = area
$\frac{dp}{dx}$ = pressure gradient

It is seen that if the clearance is uniform the pressure gradient becomes zero and Reynolds' equation reduces to Petroff's. In both cases the friction torque is obtained by multiplying the expressions by the radius of the bearing. Assuming steady running conditions and using an incompressible lubricant, Reynolds obtained from the general equation of the hydrodynamic theory the expression

$$\frac{dp}{dx} = 6\mu U \frac{h - h_1}{h^2}$$

The solution of this equation yields, for a given speed, viscosity and clearance, the value of the pressure at any point of developed bearing arc.

All existing formulas for bearing design are based on these equations deduced from the hydrodynamic theory.

In our bearing design we operate with the following expressions for the values of the coefficient of friction and minimum oil film thickness :

$$f = const\ \sqrt{ZN/P} \quad \text{.....(1)}$$

$$h = const\ r\ \sqrt{ZN/P} \quad \text{.....(2)}$$

where the value of the constant depends on the type of bearing, shape of the oil film, leakage factors, etc. These expressions can be plotted on a performance curve after the constants have been properly calculated. Stresses and deflections in the shaft and bearing shell are not accounted for in the hydrodynamic theory. Moreover, such phenomena as thermal expansion and the resonant whirling of shafts running in well lubricated journal bearings at speeds of about two times the critical speed or higher, cannot be taken into account by the hydrodynamic theory.

As mentioned before the performance of a designed bearing can be calculated when the values of the coefficient of friction, minimum oil film thickness, and temperature of oil in the film are known. First the temperature in the oil film has to be estimated in order to figure the viscosity of the oil. It is evident that experimentally it is difficult to record this temperature correctly, and correlate it to the temperatures of oil at places where it can be easily recorded, as at inlet and outlet.

The difficulty in this problem is apparent from the following comparison. The metal serves only as a conductor of heat, the coefficients for which can be precisely obtained, while the film serves both as a conductor and as the medium in which the heat is being generated. It was found that the temperature distribution is parabolic

$$\Delta T = \frac{1}{2}\left(\frac{\mu}{k}\right)U^2$$

where k is the heat transfer coefficient.

It is interesting to note that the temperature drop is independent of the film thickness. For practical purposes some other simple methods are used for figuring the average oil film temperature from which the viscosity is found. Some

SUCCESSFUL sleeve bearing design is not based entirely on theory, but combines the theoretical with the practical. In this abstract of a paper presented before the Engineering Society of Western Pennsylvania, Mr. Tichvinsky, a Westinghouse engineer, reveals how test data can be correlated effectively with design calculations.

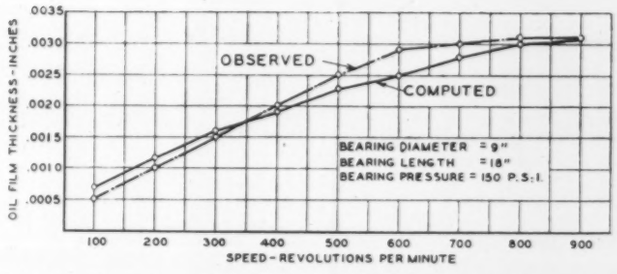


Fig. 4—This chart shows how much the component values of oil film differ from those measured. In finely bored small bronze bushings a film of the order of 0.001 inch will be sufficient, and for ordinary commercial bearings with steel shaft and babbitted shell a thickness of oil above 0.00075 inch should be maintained

engineers base their calculation on the values of inlet and outlet oil temperatures; others on the steady heat flow data from the oil to the bearing shell and from the latter to the ambient air by convection and radiation. Drawing from previous experience, practice or tests, an assumption of the average or maximum temperature is sometimes made in designing. The temperature being determined by one of the methods, the value of the characteristic number can be found. Speed and pressure usually are given and figured from preliminary drawings. With the use of several factors which take care of the type of bearing and shape of oil film, the so-called theoretical values of the co-efficient of friction are plotted. With the value of the coefficient of friction and the given peripheral speed (V ft./min.) and load (W lb.) the losses are immediately obtained from known formulas

$$Losses = \frac{f.V.W.}{K} \quad \text{.....(3)}$$

where k = 33,000; 44,300 and 46,700 if losses expressed in horsepower, kilowatts or B.t.u. per sec. respectively.

Using the proper factors the value of the oil film thickness is obtained from the second expression. The flow of oil is determined as a function of the oil film thickness, axial length of the bearing and peripheral speed with proper factors.

More accurate calculations of bearing losses, especially on large size bearings, also take into account the losses in the upper half of the bearing. When the clearance in this part is filled with oil which is not building up a pressure, as in the case of the lower part, the losses due to pure shear in the oil may be of appreciable magnitude. From the expression of the shearing force in the upper part, $F = K(Z.A.U./h)$, (K — constant; Z — viscosity in centipoises; A — area, in. sq.; U — peripheral velocity, in. per sec.; h — clearance, in.), it is seen that larger clearances offer smaller friction forces. The

(*Concluded on Page* 81)

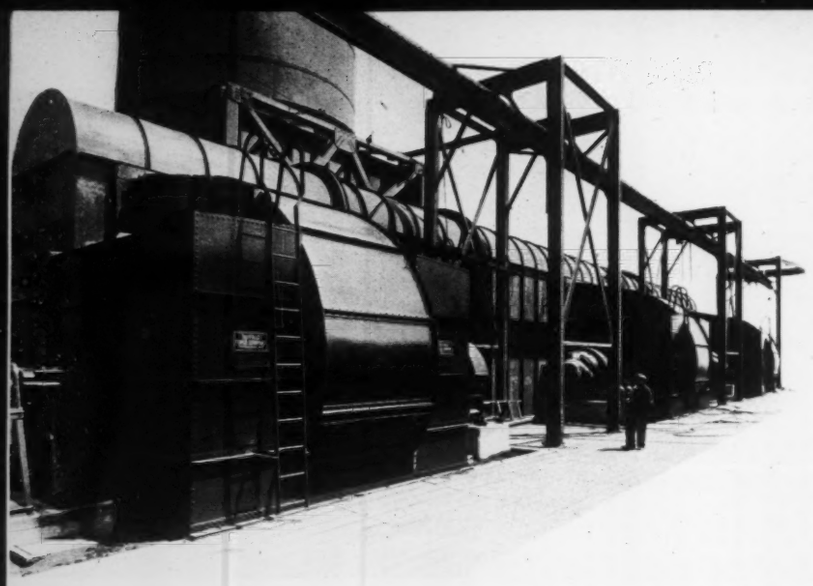


Fig. 8—These induced draft fans are the largest of their type ever built. Wheel flanges and center plates are nickel steel

Special Materials (

By William C. Willard
Buffalo Forge Co.

SELECTION of the particular alloy best suited for application to fans depends upon several considerations, some of which were brought out in the first section of this article, published on page 22 of the March issue of MACHINE DESIGN. These considerations include the unit stresses encountered, elevated temperature, corrosion and abrasion, procurable mill delivery, etc. A rolling mill often requires from four to ten weeks for a rolling of special alloy metal. An appreciable volume of fan business is placed entirely on a delivery basis.

Price and quality of product usually are the governing considerations. When delivery is paramount, the manufacturer who can guarantee the most prompt delivery gets the business. Hence, the fan manufacturer cannot wait four to ten weeks for special rolling of material from the mill. Often the fan designer must take the alloy for which the quickest mill delivery can be secured, and design the fan accordingly. Thickness and rectangular size of sheets, diameter and length of bars, and size of structurals affect elapsed time of delivery.

Continuing the discussion of selection factors begun in March, this section of the article will consider resisting abrasion, reducing weight, reducing fire hazard, and dampening vibration.

Selection Factor (4) *Resisting Abrasion.*

Of all the destructive agencies encountered in fan operation, abrasion is probably the most troublesome. It is encountered in blowers handling powdered coal, in induced draft fans handling exhaust gases from powered coal burners, in fans used in lime and cement mills and sintering plants, in grain conveyor fans of distilleries, the fans of centrifugal gas scrubbers, and the great variety of uses to which the ordinary mill type exhaust fan is subjected.

Abrasion occurs principally on the blades of the fan wheel and the scroll of the fan housing, the "scroll" being the spiral part of the housing lying between the sides. Although abrasion, when present, is most troublesome, the use of special materials to resist abrasion is less extensive and as a whole less effective than with other destructive agencies. Experiments with several metallic alloys for fan wheel blades have proved that where severe conditions of abrasion are present, such as exist in fans handling exhaust gases from powdered coal burners, ordinary carbon steel stands up about as well as any of the more costly alloy steels. In general, this condition is best met by special features of design, such as the use of "wearing strips" of carbon steel on fan blades at the places where maximum abrasion occurs.

There are, however, some conditions of abrasion where the added cost resulting from the use of special material is justified. Chromium nickel alloy steels of the 18-8 type, the 19-9 and 24-12 types have been used with varying degrees of success for combatting abrasion of fan wheels in lime and cement mills. Also, it is said by some engineers that the blades of fan wheels handling dry grain in distilleries have a much longer life if fabricated from hard copper instead of steel.

Abrasion of the scroll sheets of wrought housed fans is best combatted by the use of re-

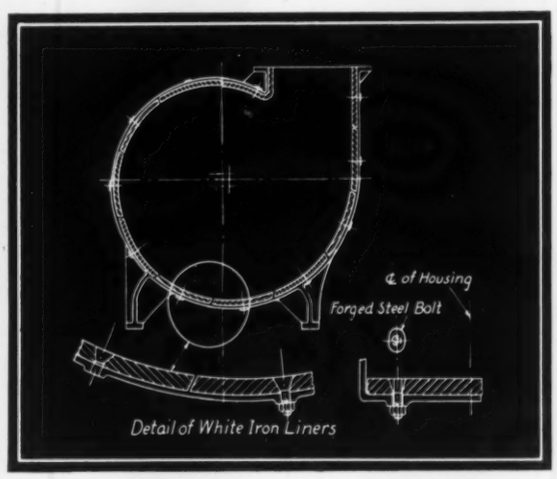
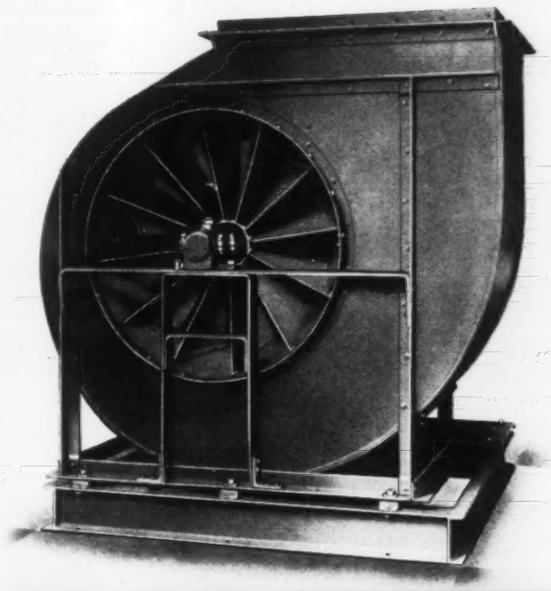
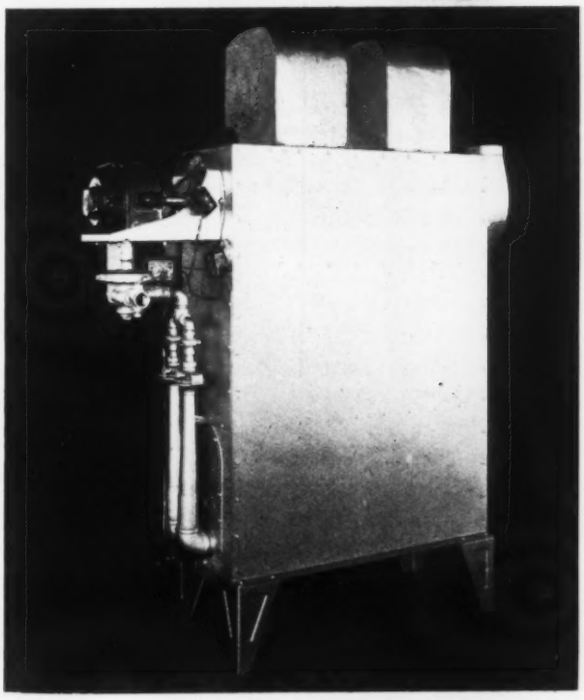


Fig. 9—Cast-iron-housed fan has removable cast white iron scroll liners with hardness of 375 brinell

als Open Door to Design Success

Part II





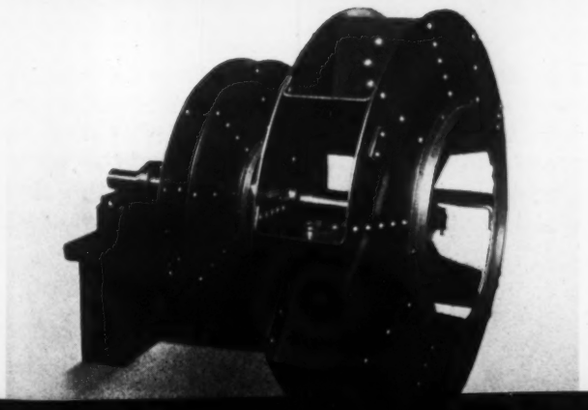
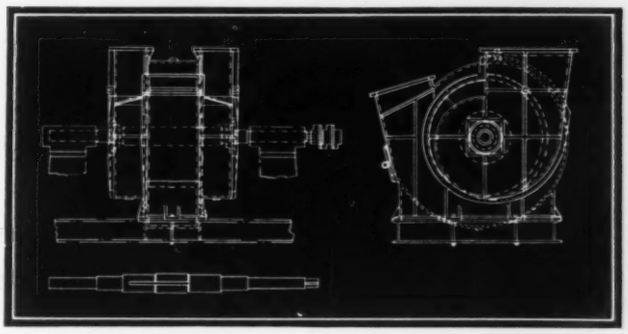


Fig. 10—Top—Floating base for ventilating equipment insures smooth operation. Fig. 11—Center—Fire sheet enclosing the combustion chamber of this gas-fired unit heater is of Allegheny 33 metal. Large flues are brass tubing while small flues are aluminum tubing. Fig. 12—Bottom—Aluminum alloy wheels employed in government dirigibles

Fig. 13—Below—Shaft in this unit for handling moist hot gases is made of a high carbon-manganese alloy steel



newable cast iron or wrought carbon steel liners. For cast gray iron housings of fans handling powdered coal, such as the "Volume" type fan, cast white iron scroll liners resist abrasion extremely well. These white iron liners should have a brinnell hardness above 350. They are un-machinable and their use entails additional pattern expense.

Abrasion and corrosion have been discussed separately. As a matter of fact, where either of these destructive agencies exist the other is likely to be present in greater or lesser degree. The fan wheels of centrifugal gas scrubbers described under the subject of corrosion also are subjected to severe abrasion. The several metallic alloys used in their construction combat corrosion with entire success, but not so with abrasion. Ultimately, failure of these wheels results from abrasion.

Under certain conditions of operation, such as exist when handling poisonous or explosive gases, fan housings must be gas tight. This requires the placing of a stuffing box around the shaft where it passes through the housing. One

or two stuffing boxes may be required depending on fan drive arrangement. A worn packing gland which is allowed to rub against the shaft, improperly lubricated packing, or the infiltration of abrasive substances into the packing gland either from within or without the fan housing, will soon produce a worn shaft in the stuffing box. When wear once starts at this locality, it is impossible to keep the packing tight and the condition rapidly grows worse. For installations where this stuffing box condition is inherent, hard-surfacing of the shaft throughout its length through the stuffing box adds greatly to the life of the shaft. A hard-surfacing material such as that known under the trade name of Stellite is fused to the shaft

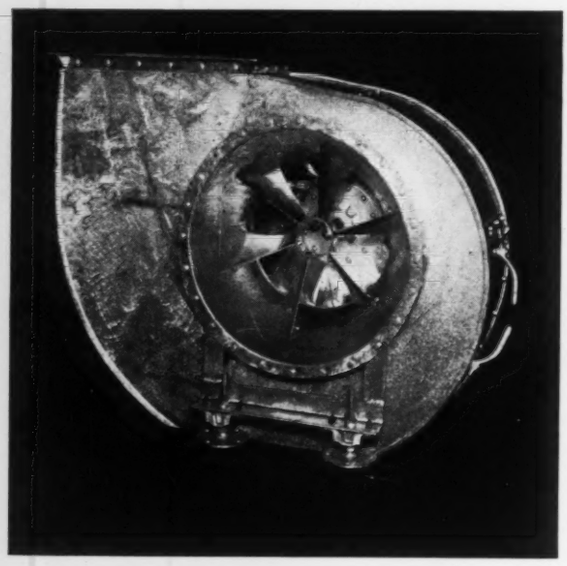


Fig. 14—*Hot-dipped galvanized housings are suitable for Navy service. Height is adjustable by use of the special marine type vibration dampeners*

by arc welding. The thickness of this material may range from 1/16 to ¼ inch and its addition to the shaft requires expert manipulation to prevent cracking. This welded area is then ground to the desired shaft diameter.

Selection Factor (5) *Reducing Weight.*

The requirement of reducing weight in fan construction may be considered in general from three standpoints which are: Aircraft vessels; marine naval vessels; and the desire for or necessity of reducing unit stresses in a rotating fan wheel by reducing its weight.

The need for reducing the weight of all parts of aircraft vessels to a minimum, whether of the heavier than air or lighter than air type vessel, is fundamental. Reduction in weight is accomplished in fan construction by the use of aluminum and its alloys, high strength alloy steel, and special design features. For parts of the fan subjected to low stresses, such as the housing, commercial wrought aluminum, designated by its manufacturer as "2S" is sufficient. For parts subject to high stress, a high-strength aluminum alloy is used. In the wrought form these are variously designated by the Aluminum company as 17 ST (Duralumin), 51 S, etc. In the sand cast form they are designated as alloy 112, 195-4 etc. The strength of certain sand cast aluminum alloys is improved by heat treating, as in the case of alloy No. 195. The numeral following the number 195 desigtes the particular heat treatment desired.

Aluminum Reduces Weight

Fig. 12 shows one set of fan wheels which were used for engine cooling and exhaust condensing in the dirigibles AKRON and MACON, eight sets being used in each vessel. The wheels were duralumin throughout. Wheel spiders were machined from solid forged disks. The two wheels were mounted on a single hollow shaft made of S.A.E. No. 3140 alloy steel, heat treatment No. 7. One wheel was attached to the shaft by means of a serrated steel bushing, the outside diametral dimensions of which were approximately .002-inch larger than the corresponding dimensions of the bore of the duralumin spider. Because of the relative softness of the aluminum alloy, it was impractical to use pressure for forcing the steel bushing into the spider. The bushing was shrunk in size by immersion in liquid air and then was slipped easily into the bore of the spider.

Space and weight limitations are much the same for naval underwater craft as for aircraft. The limitations of fans for surface water craft are less exacting. For this service usually the bulkier parts are made of aluminum in order to reduce weight, while the more highly stressed parts of the fan wheel are wrought steel, cast steel or cast bronze.

Shaft Size Is Important

The designer often encounters weight limitations imposed by conditions such as the diameter of the shaft of a motor upon which a fan wheel is to be mounted. Or it may be desired to reduce the cost of the fan unit by keeping the size of the shaft, and hence size of bearings, as small as possible. The cost of fan bearings is an appreciable percentage of the total cost of the unit. It is seldom that the size of a fan shaft is governed alone by its torsional strength. The critical speed of the shaft usually is the governing element. Critical speed is a function of shaft deflection, and shaft deflection is a function of combined weight of the shaft and wheel. Therefore, if the fan designer is able to reduce the weight of the wheel, he may be able to reduce the size of the shaft and still maintain the necessary margin of safety

above operating speed. He may do this by the use of light-weight metals or by using thinner gages of high-strength alloy steels.

Selection Factor (6) *Reducing Fire Hazard*

Fans are used frequently for moving gases which are inflammable, or for moving air which carries in suspension minute particles of solids. Often the latter is highly explosive. Where frequent explosions of small magnitude are likely to occur only in the fan and are not capable of being transmitted to other parts of the system, explosion doors may be placed in the fan housing. These are covered with canvas or heavy paper and are sufficiently strong to withstand normal working pressure but burst readily under pressure of an explosion, thus preventing damage to other parts of the fan.

The generally used method of preventing explosion within a fan is to fabricate all or part of the apparatus from a nonsparking material. Brass is the most commonly used material for this purpose. Aluminum may also be used. Monel metal and Everdur are practically nonsparking but a spark can be produced from either metal under certain conditions. The construction usually followed makes use of a wheel fabricated from brass or one of the other nonsparking metals, while housing is standard steel. Some users desire both wheel and housing to be nonsparking. Where only one part is to be of nonsparking metal, it is preferable for the wheel to be this part because of the danger of metallic objects of a sparking nature being drawn against the wheel by its suction. A surprising array of foreign objects find their way into the suction of a fan, including tacks, nails, small tools, even crowbars.

An operating fan of steel construction generates static electricity. If electrical conductivity exists between wheel, shaft, bearings and housing, sparking will not occur between wheel and most proximate part of housing. If bearings are mounted on rubber in order to dampen vibration, sparking will occur between rotor and housing if one bearing is not grounded.

One other danger from sparking lies in the possibility of some part of the wheel becoming detached therefrom and striking the housing. This contingency is taken care of best by fabricating the wheel from steel and the housing from brass. For fans of large size, such as those used in exhaust systems of chemical plants, this arrangement has proved satisfactory.

Selection Factor (7) *Resisting Vibration.*

Structural vibration is objectionable in many installations because of its translation into noise. Vibration of fans may result from dynamic unbalance of the rotating parts, operating within the critical speed range of the shaft, a critical structural vibrational period of the rotating fan parts and their entire supporting structure, laces in a flat belt, pulsations of a reciprocating engine, insecure supports for the shaft bearings, improperly adjusted shaft thrust collars, misalignment between the halves of a flexible coupling connecting fan and motor or turbine, and excessive "float" in the armature of a motor directly connected to a fan.

Refinements in the accuracy of installation will prevent or cure much of this trouble. The complete elimination of dynamic unbalance is costly and unwarranted in the ordinary heating and ventilating fan. For fans operating at moderate speeds a more satisfactory means is to dampen vibration, rather than attempt to eliminate it. This is accomplished effectively in small units by mounting the shaft bearings on rubber pads.

Fig. 15—*All sheet metal parts of fan for silk mill service are fabricated from copper-bearing steel for corrosion resistance*

Dampening the vibration of larger fan units is accomplished best by mounting the fan and its driving motor on especially designed rubber shock absorbers. *Fig.* 10 illustrates a "floating" fan base which is very effective. This base in its several adaptations is patented.

A foundation of cork under the entire fan unit has been used successfully for dampening vibration. This is considerably more expensive in cost of installation than the rubber-mounted floating base. Cork is also used as a vibration or noise dampener directly under fan shaft bearings and in some designs of antifriction bearings cork is placed inside the bearing between the outer ball race and the pillow block.

THE END

Attractive Finishes Bring Boost in Sales

New Book, Reviewed Here, Will Assist Designer in Selection of Finishes

UTILITY alone will not meet the present complex and competitive conditions of our industrial life, Herbert R. Simonds points out in his new book, *"Finishing Metal Products."* A machine or product, as the case may be, must have sales appeal. While utility is, of course, essential, designers must not overlook appearance.

Some idea of the scope of his work may be gained from the contents, consisting of six parts: Commercial aspects of finish and appearance; preparation for the finish of metal products; polishing and buffing; plating and spray coating; painting; special finishes. Each section is divided into chapters which bring to designers information that offers considerable aid. Section one, for instance, discusses such subjects as sales value of attractive finish, the problem of selection, plating characteristics, importance of color, and prefinished raw materials.

Color Gains Prominence

An extremely useful feature is the brief note at the beginning of each chapter, which highspots the contents for the reader. Before launching the discussion on color, for example, Mr. Simonds introduces this paragraph: "Sales of a wide variety of metal products have been increased through the use of different colors or color combinations in finishing. The simpler colors were used at first because of the cost and technical difficulties involved in the use of the more complicated shades. Now, however, lacquering and enameling processes have so far developed that the manufacturer is not handicapped in his selection of color. The question naturally arises, what color will have the best sales appeal? This and other questions relating to the use of color in finish of metal products are here discussed." Few readers could resist reading this chapter after scanning that intriguing introduction.

Particularly interesting are the case studies involving actual experiences of manufacturers, such as this one which incidentally follows the paragraph quoted above. "A manufacturer of typewriters found sales lagging and called a meeting to discuss means of stimulating trade. Someone made the startling suggestion that typewriters, which until then had been offered in a black finish, might be advisedly finished in various bright colors. After considerable hesitation this was finally done, and sales immediately started to improve. Here in a very real sense was a case where rainbow shades took the company out of the red."

Production Problems Discussed

Part two goes to some extent into production angles with which designers might well familiarize themselves. It treats cost and value of cleaning; how to minimize cleaning expense; cleaning as a production process; pickling for better finish; pickling as a manufacturing process; selecting the pickling equipment; and abrasive cleaning. In the succeeding section we find covered such subjects as polishing in industry, wheels and materials, polishing different metals, designing products to reduce polishing expense, and the design of polishing and buffing fixtures.

As the book uncovers the many phases of the subject of finishing, the reader finds information on cadmium, chromium and copper plating; nickel, zinc and other metallic coatings, as well as spray coating. There also is a section on painting which covers preparation for paint; painting for protection; enameling and lacquering. In the concluding chapters of the volume are discussions dealing with coloring aluminum, porcelain enamel, novelty coatings and synthetics.

The book, published by McGraw-Hill Book Co. Inc., is available through MACHINE DESIGN for $3.50 plus 15 cents postage.

New Machines Indicate Design Trends

RELIABLE, built-in lubricating devices provide the most positive means for insurance of continued user satisfaction that is available to the designing engineer. There are a number of systems offered for providing this lubrication, and with them the designer can be certain that the product of his efforts will not be mistreated by the purchaser. The possible life of the machine depends on careful treatment. The designer who cuts costs with poorly designed lubrication facilities destroys a considerable portion of his user's good will.

Machines recently announced in addition to those on the next two pages include the following, arranged by fields of application:

Construction

Cement Mixers, Jaeger Machine Co., Columbus, O.

Portable Crushing and Screening Plant, Diamond Iron Works Inc., Minneapolis.

Combination Shovel, Dragline, Crane and Truck Hoe, Bay City Shovels Inc., Bay City, Mich.

Dairy

Tester, Creamery Package Mfg. Co., Chicago.

Small Homogenizer, Dodge Emulsor Corp., Detroit.

Continuous Freezer, Creamery Package Mfg. Co., Chicago.

Domestic

Built-In Ventilators, Ilg Electric Ventilating Co., Chicago.

Oil Burners, Timken Silent Automatic Co., Detroit.

Vacuum Cleaners, Electric Vacuum Cleaners Inc., Cleveland.

Ironers, Crosley Radio Corp., Cincinnati.

Oil Burning Air Conditioning Units, Herman Nelson Co., Moline, Ill.

Food

Portable Mixer, Paterson Foundry & Machine Co., East Liverpool, O.

Glass

Pressing Machine, Lynch Corp., Anderson, Ind.

Industrial

Hydraulic Pressure Booster, Martin-Decker Corp., Long Beach, Calif.

Power Wrench, Cushman Chuck Co., Hartford, Conn.

Oil Fired Heating Boiler, National Radiator Corp., Johnstown, Pa.

Air Compressor, American Chain Co., Bridgeport, Conn.

Unit Coolers, General Refrigeration Sales Co., Beloit, Wis.

V-8 Diesel Engines, Caterpiller Tractor Co., Peoria, Ill.

Refrigerating Units, Frick Co., Waynesboro, Pa.

Metalworking

Hydraulic Planer, Rockford Machine Tool Co., Rockford, Ill.

Seventy-Five Ton General Utility Press, Baldwin-Southwark Corp., Philadelphia.

Carbide Tool Grinder, Ex-Cell-O Aircraft & Tool Corp., Detroit.

High Production Wire Forming Machine, Economy Tool & Machine Co., Muskegon Heights, Mich.

Automatic Screw Machine, Windsor Automatic Co. Inc., Windsor, Vt.

Radial Slide Lathes, Gisholt Machine Co., Madison, Wis.

Mining

Strip-Pit Drill, Hardsocg Mfg. Co., Ottumwa, Ia.

Municipal

Street Striper, Lewis Mfg. Co., Decatur, Ill.

Packaging

Bottle Wrapping Machine, Miller Wrapping & Sealing Co., Chicago.

Printing

Paper Cutter, Challenge Machinery Co., Grand Haven, Mich.

Pharmaceutical

Rotary Tablet Press, Lux-Lohner Machine Co., Chicago.

Textile

Pattern Rib Machine, H. Brinton Co., Philadelphia.

Stroboscopically Controlled Knitting Machine, Hemphill Co., Pawtucket, R. I.

Inspection Machine, Birch Bros. Inc., Somerville, Mass.

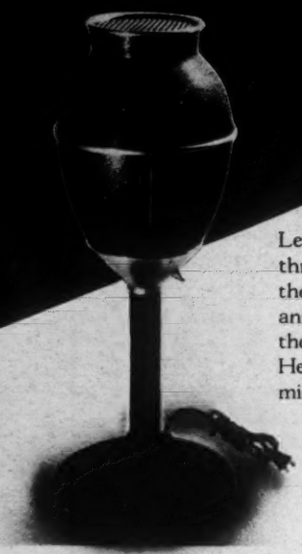
Fabric Machine, Hemphill Co., Pawtucket, R. I.

Welding

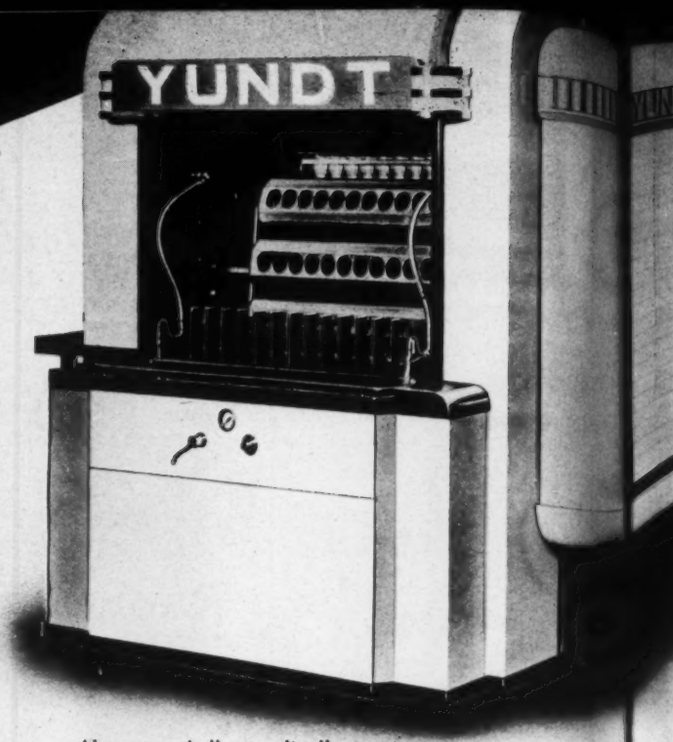
Portable Vertical Welder, Harnischfeger Corp., Milwaukee.

Woodworking

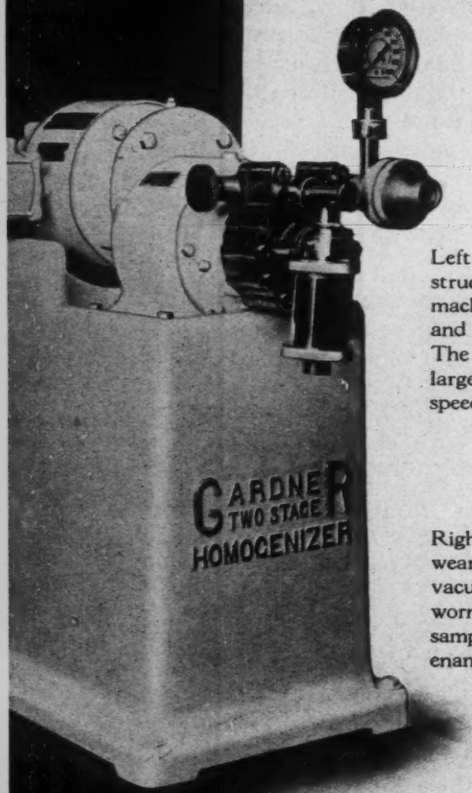
Workshop Lathe, Emrick Machine Co., Kalamazoo, Mich.



Left — By simply removing three small set screws from the top grid the entire mechanism can be withdrawn from the copper housing of this Hexcel portable electric humidifier.

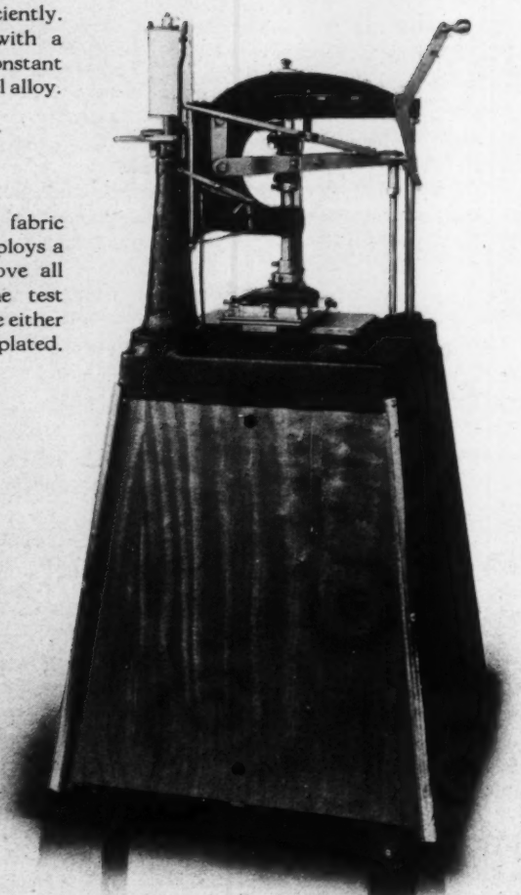


Above — A "streamline" covering, hiding all moving parts, enhances the appearance of the Yundt bottle washer. Sliding sides obviate any sacrifice of accessibility.



Left — Two-stage valve construction enables the Gardner machine to homogenize milk and milk products efficiently. The unit is equipped with a large heavy-duty slow constant speed pump made of nickel alloy.

Right — The Shawmut fabric wear testing machine employs a vacuum process to remove all worn material from the test sample. Exposed parts are either enameled or chromium plated.



Right—Flexible drive adjusts speed of upper cylinder in this Goss mat roller which permits deep molding of dry newspaper mats with little stretch. A double reduction worm drive and a solid steel cylinder are employed.

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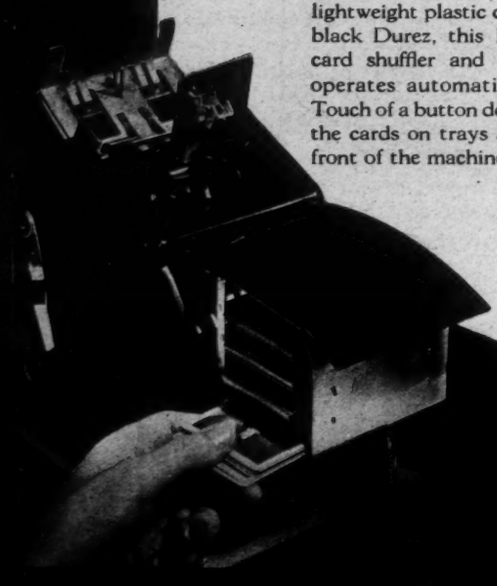
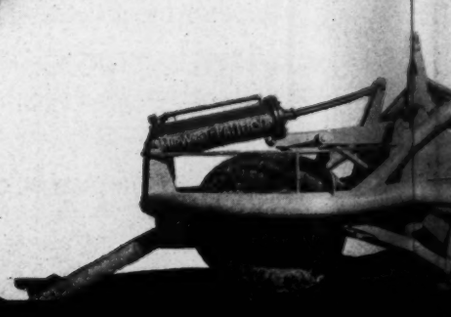
Below — Housed in a lightweight plastic case of black Durez, this I-Deal card shuffler and dealer operates automatically. Touch of a button delivers the cards on trays at the front of the machine.





Right—Light weight, compactness and clean appearance characterize the portable time recorder designed by International Business Machines Corp.

Right — In this Baldwin-Southwark shingle testing machine, load is supplied by a small motor-driven nut that moves the middle crosshead downward. Control of the motor at each end of the stroke is effected by a limit stop, obviating damage to parts. Welded steel construction is employed in the transverse supports.

lexible dr e adjusts upper c inder in mat r er which eep mol g of dry mats th little A doubl eduction e and a olid steel e emplo d.

sign Features New Machines

orial Presentation of Recent Machinery from the Standpoint of Design.

Below — Universal motor powers Alemite lubrication power gun. Portability is combined with simple construction that allows quick access to all moving parts.

Left — Seamless steel tubular frame serves as an air reservoir or pressure tank as well as the main supporting member of this Midwest air-powered scoop. All welding was done by shielded arc process with Lincoln equipment.

Knowledge Cannot Become "Specialized" without Broad Basic Foundation

ONE of the more youthful readers of MACHINE DESIGN asks if specialization offers any advantages. He is in a quandary as to whether he should try to learn a lot about one thing or a certain amount about many.

This problem has troubled older and possibly wiser men than he. Too often have engineers found themselves in a deep rut because they have concentrated on doing one job so thoroughly that their minds are a blank on all else.

As W. H. Carrier of the Carrier corporation said recently: "In my own experience, and I can well believe it is typical of the experience of most others who have been pioneering in engineering, the sources of any idea almost invariably comes from contacts with other fields rather than one's own."

The inference is obvious. Engineers—and designers of machinery in particular—cannot afford to close their minds to what is happening all around. Specialized knowledge, supplemented by information gleaned by experience or study of developments taking place in other branches of the profession, marks the progressive and sought-after engineering executive.

Credit the Machine!

CORROBORATIVE evidence keeps cropping up in support of the contention that the new, highly mechanized industries are furnishing the most fruitful fields for employment. In a recent survey made by one of the largest manufacturers of electrical machinery and equipment, for instance, it was found that for the five depression years 1930-1934 the ratio between business attributable to new lines of products and total business for all lines was approximately ten per cent higher than for the five prosperity years 1926-1930.

This supplements the statement made by the National Industrial Conference Board to the effect that the electrical machinery and seventeen other "machine created" industries that have come into existence since 1879 accounted for thirteen per cent of wage earners in 1929 and for forty per cent of the increase of wage earners from 1879 to 1929.

In other words, it is the new machine-made products that are now providing employment. Lacking the machine—and the consequent capacity for turning out new goods economically—unemployment figures would be even higher than they are.

Professional Viewpoints

MACHINE DESIGN WELCOMES LETTERS SUITABLE FOR PUBLICATION

Auxiliary Lights Aid Operation

To the Editor:

IN CONNECTION with the article on built-in lighting published in the January issue of MACHINE DESIGN, you will probably be interested in the practice of our company. Our larger tools are not supplied with lights as the requirements for auxiliary lighting will vary in the different shops, depending on the shop illumination and on the type of work. There is, however, one standard machine tool which we frequently furnish with lights. This is the drill grinder shown in the accompanying illustration. This machine drills down to 1/16-inch diameter, requiring close observation, and we have found an individual light very desirable.

Flexible cable provides ready adjustment in height and angle of light

The light is of the attached variety and is not built-in. This is partly because not all machines are furnished with a light. Furthermore, it is convenient to be able to adjust the position to suit the height of the man, height of the machine from the floor and the size of the work. It is necessary to see the edge of the drill clearly when bringing it in contact with the wheel in order to avoid sudden hard contact which would tend to waste drill material and damage the wheel. A flexible cable fixture provides ready adjustment in height and in angle. The switch in the lamp socket provides means for turning the light on and off. It may be operated independently of the motor switch.

Some users prefer to have all individual machine lights connected so that the lights go out when the machine is shut off. On machine tools this has not been generally practiced because of possible need for light when the machine motor is stopped. The practice of lights operating with power will show to advantage on quiet-running machinery, giving an indication as to whether or not the machine is in operation, and thus is an added safety precaution.

—COLEMAN SELLERS 3RD, *Exec. Engr.*,
William Sellers & Co. Inc.

Designing Helical Springs

To the Editor:

WE HAVE read with interest Mr. Whiting's article in your February issue entitled "Easing the Designer's Load in Selection of Springs." We note one error, probably typographical, in the third paragraph, which should read 10,000,000 pounds per square inch torsional modulus.

Our experience as spring manufacturers, whereby we have occasion to design springs, leads us to believe that many spring problems are a case of redesign and do not readily permit the use of a chart. We also find that this type of chart is usually not sufficiently accurate for our purposes.

In connection with the allowable torsional working stress of springs operating at elevated temperatures, we have found it is difficult to chart a positive figure for these values since increased time at elevated temperatures seems to result in increased settage. In other words, whereas at normal temperatures a spring might become stable in length, it is difficult to locate a point of stability when springs are operated at elevated temperatures.

On the whole, we would consider this article a very excellent summary of recent existing technical information on spring design, although we

believe that inasmuch as so many variables have been presented, that for designers who are not already somewhat familiar with helical springs it might be somewhat confusing.

—ROBERT C. JORDON,
Wickwire Spencer Steel Co.

To the Editor:

THE ARTICLE on coil spring design by H. W. Whiting of Skinner Engine Co., which appeared in your February issue is, insofar as I know, the first really comprehensive article that has ever appeared any place on the design of these parts. At the present moment I am very much interested in getting similar information on flat steel springs. These springs, I know, must have different factors as the thickness of the spring is changed, but up to the present time, it just seems impossible for me to get the information that I want.

—CHARLES P. GRIMES,
E. A. Laboratories Inc.

To the Editor:

THE article by Harold W. Whiting in the February issue of MACHINE DESIGN should prove of considerable interest and value to spring designers, particularly since a large amount of more or less scattered data on spring design and materials has been brought together into convenient form. In applying the suggested values of working stress to actual practice, however, it is the writer's opinion that considerable caution must be exercised, especially where springs are under severe working conditions or when failure is a serious matter. In such cases the use of a value of working stress considerably less than two-thirds the value for light service (see *Fig.* 1 p. 19 Feb. M. D.) may be required.

Presents Fatigue Tests

As an example, take the case of .063 inch diameter music wire, for which from *Fig.* 1 an allowable stress of about 135,000 pounds per square inch is proposed, assuming Class 3 (light) service. Using the suggested value of two-thirds of this for Class 1 (severe) service, an allowable stress of 90,000 pounds per square inch is obtained. However, fatigue tests on music wire springs of this size, made by Mr. Hengstenberg of Westinghouse Laboratories, show an endurance limit[1] of but 76,000 pounds per square inch under a stress range from zero to maximum continuously (which corresponds to severe service). Similar fatigue tests on .225 inch diameter music wire springs show an endurance limit of 65,000 pounds per square inch, while two-thirds of the value given for this size wire in *Fig.* 1 is 70,000 pounds per square inch. Hence it appears that to have a sufficient margin of safety in such cases (which, to be sure, constitute unusually severe service) a value of stress considerably less than two-thirds the values given in *Fig.* 1 should be used, or else special precautions must be taken in the manufacture of the spring to obtain higher endurance limits.

The writer would also like to mention the important influence of the stress range on the endurance limit of the spring. This is brought out by fatigue tests by Zimmerli[2] on small helical springs, both of carbon and alloy steels, which indicate that with a stress range from half the maximum to the maximum, the endurance limit (defined here as the maximum stress which the spring will stand continuously) was about 30 to 40 per cent higher than that obtained under a stress range from zero to a maximum. In the former case, therefore, the allowable stress may be 30 per cent or so higher.

Must Watch Corrosion

It should also be mentioned that where corrosion occurs, even in very slight amounts, the endurance limit may be reduced to a fraction of the value without corrosion.

Summing up this point, in view of the limited amount of fatigue test data available, it appears that a considerable amount of judgment must be applied to the selection of working stresses for springs. Hence, in cases where the service is unusually severe (such as occurs, for example, when the stress range approaches the maximum stress) or where failure of the spring is a serious matter, it seems advisable to consult the spring manufacturer, particularly since advantage may be taken of recent developments in spring materials and manufacturing technique.

Referring to *Fig.* 2 of the paper, for steel a modulus of rigidity of 12 x 10^6 pounds per square inch is proposed for very small wire diameters, this figure dropping off linearly to a value of 10 $\times$ 10^6 for 1½ inch diameter wire. No doubt this curve is based on practical experience, but it is difficult for the writer to understand why the modulus of rigidity, considered as a property of the material, should vary by such a large amount for different wire sizes. It seems possible that the low value of modulus used for the larger sizes of wire may be required to compensate for inaccuracy in estimating the effective number of end coils, or possibly for the effect of internal stresses due to cold work. The writer would be interested in knowing whether any tests have been made wherein the effect of the end turns was eliminated by measuring deflections in the body of the spring. Such tests, combined with torsion tests on straight bars, would show whether or not the low value of apparent modulus for the

[1] All stresses are figured using a factor to take into account curvature of the wire. See Wahl, MACHINE DESIGN, May to August, 1930.

[2] Univ. of Michigan Department of Engineering Research, Bulletin No. 26, July, 1934.

larger sizes is due to the end turns or internal stresses, or whether it is inherent in the material itself.

A. M. Wahl,
Westinghouse Research Laboratories.

To the Editor:

COMMENTS on engineering matters, such as those prepared by Robert C. Jordon and A. M. Wahl on my article which was published in the February issue of MACHINE DESIGN, materially aid in the clarification of problems.

Answering Mr. Jordon, the author did not presume that the factors listed in the chart would provide a last word in the design of springs against the experience of spring manufacturers, but did try to convey to designers the thought that the dimensions of a spring vary considerably according to temperature, class of materials and the service to which they are subjected. The chart will provide, in the author's opinion, a basis from which the designer may work after which the spring manufacturer should, of course, be consulted before selecting the ultimate design. Mr. Jordon will no doubt agree that too often designers neglect the proper design of a spring and expect the spring manufacturer to fit the spring into the limited space provided, with the result that the spring will not given the service that is expected of it.

The author feels that the foregoing reply to Mr. Jordon will, in part, answer the comments of Mr. Wahl. If in Mr. Wahl's opinion the stress ranges used are higher than those he would use through his experience with springs, it is only necessary for him to substitute in the tabulation on page 20 of the February issue, those values that are dictated by his experience. Basically the main chart is correct.

Regarding the last paragraph of Mr. Wahl's comments, the author conducted numerous tests on large springs and feels as Mr. Wahl has indicated that the lowering of the modulus of rigidity for larger diameter wire is due to the cold working of the coils as the effect of the end coils was measured with the equipment at hand. This change in the modulus is recognized by various authorities for larger diameter wires.

—H. W. WHITING,
Skinner Engine Co.

Do Engineers Lack Proper Training?

To the Editor:

ONE LINE in Professor Ault's article "Do Engineers Lack Proper Training?" (M. D. Feb. p. 46) has caused me to take issue with him. He states: "Students at Case MAY (the emphasis is my own) take a course in effective speaking."

That one word 'may' strikes at the fundamental cause of the engineer's misunderstood profession. If he were compelled to take a course in effective speaking he would not have his present difficulty in selling himself and his ideas to the public in general and to the business world in particular.

Why is it said that the engineer is cold, unsociable, almost anti-social? For the simple reason that his training is so uniformly technical, so circumscribed, so factual that he is unable to rub shoulders with those whose experiences result from either academic or business contacts.

But let us assume for the sake of argument that he has these broader concepts, he still lacks the power of effective expression to make him at home with that portion of society which does not have the engineering viewpoint.

To the engineer it has not yet become obvious that expression as a medium of verbal understanding is to the layman what the blueprint is to the engineer.

The art of getting along with people, certainly one of the very important attributes of success, is largely predicated on the individual's ability so to express himself that he does not antagonize, that he can fit into the scheme of his environment, and by means of words maneuver so skillfully that not only his ideas but he himself will become acceptable and desirable.

If the engineering schools do not recognize the importance of speaking well, engineers will continue to go out into the world with their diplomas, their technical knowledge and a "No-Sale" sign, hoping to stumble by chance into a position which might feel the need of them, that they can secure not because of their selling ability, but in spite of their lack of that most important asset: Effective Speaking.

—J. H. GEPFERT,
Reeves Pulley Co.

To the Editor:

I WOULD suggest that the greatest fault with the training of engineers is standardization. Different kinds of engineers are needed, and they should have radically different training. I do not mean a chance to select a few different subjects, but that some should have their training entirely outside of our standardized institutions.

The schools train mathematical engineers, and we need them, but there are successful engineers who know no mathematics beyond simple arithmetic. We need engineers whose principal training has been in dealing with men, with only enough technical training to see the principles of machine actions. I doubt if the majority of engineers ever use anything deeper technically than the high school physics course. Today the best opportunities for the bright boys are outside of the school system.

—A. W. FORBES,
Forbes & Myers

MEN of MACHINES

G. L. LARSON

STEEPED in knowledge of heating and ventilating, Prof. G. L. Larson, department of mechanical engineering, University of Wisconsin, is well equipped to handle the presidency of the American Society of Heating and Ventilating Engineers, to which post he has been elected.

At the University of Idaho he obtained a B.S. degree in electrical engineering in 1907, and in 1915 Wisconsin conferred a mechanical engineering degree upon him. From 1907 to 1909 he was affiliated with the General Electric Co.

He has presented numerous papers before the A.S.H.V.E. on research projects carried out under his direction in the heating and ventilating laboratory at the university. Mechanical equipment for many public buildings has been designed by him.

• • •

ROY E. COLE

THE Who's Who of the automotive engineering fraternity is long and impressive. It includes such notables as Roy E. Cole who recently joined Studebaker as chief engineer.

Mr. Cole, a graduate of Ohio State university, Columbus, O., has been identified with the motor industry for many years. In 1924 he became chief engineer of Dodge Motor Co., leaving five years later to become affiliated with the Durant company in the same capacity.

When the Rockne Motor Co. was formed in 1931 he was made its chief engineer, and after the discontinuance of that organization was associated with various other motor car companies as a consulting engineer. His engineering career has been confined entirely to automobile design.

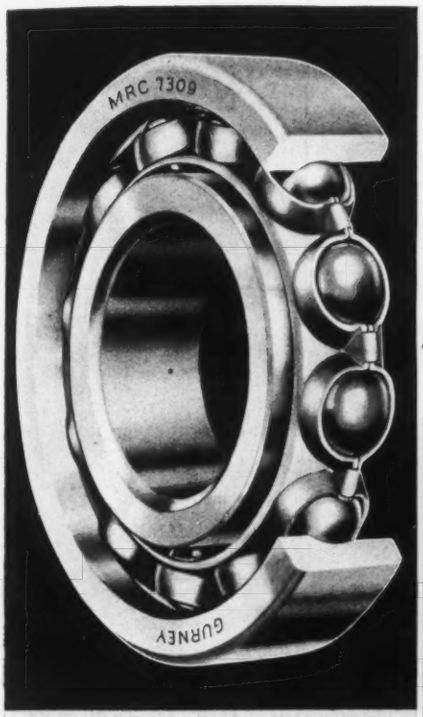
• • •

VANNEVAR BUSH

GENIUS . . . that one word personifies Dr. Vannevar Bush, vice president of Massachusetts Institute of Technology and dean of the school of engineering. He has excelled in the development of methods and devices for application of mathematical analysis to problems of electrical engineering, and thus receives the 1935 Lamme medal.

International recognition has come to Dr. Bush for his achievements in the design of analyzing instruments. One intricate calculating machine, the differential analyzer, developed at M.I.T. under his direction, is capable of solving complex differential equations (M. D. July, 1935).

He is a native of Everett, Mass., was graduated in 1913 from Tufts college, and in 1916 received the degree of doctor of engi-



Leadership

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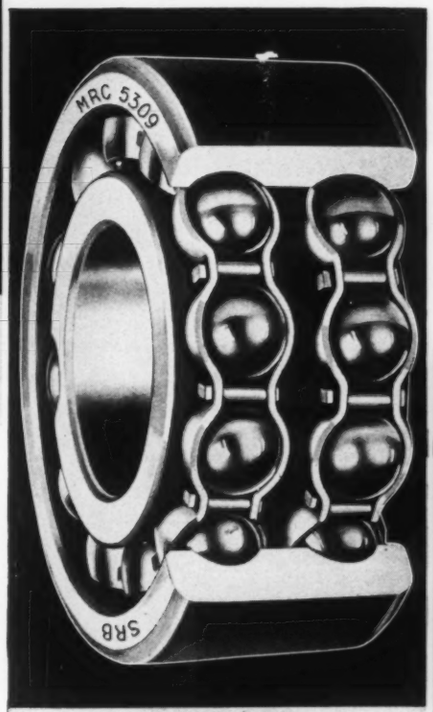
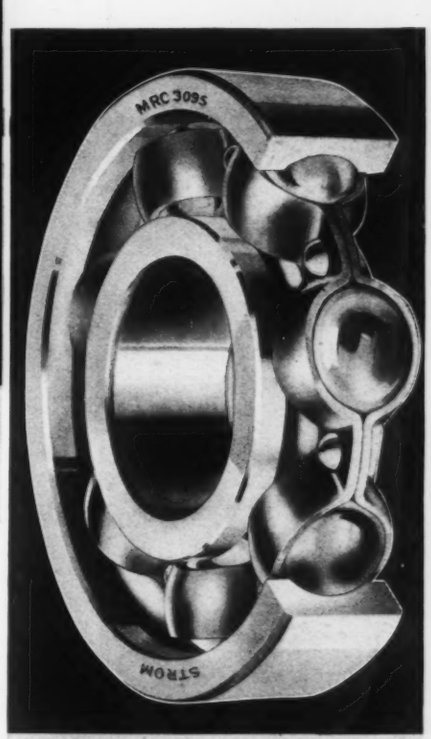


SRB
an **M-R-C** *Bearing*



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neering from Harvard university and Technology. In 1932 Dr. Bush was the recipient of the honorary degree of doctor of science from Tufts college which he now serves as a member of the board of trustees. Joining M.I.T. in 1919, his appointment to his present capacity was announced on March 10, 1932. Early in his career he held a position in the test department of General Electric, returning later to Tufts college as an instructor in mathematics. Subsequently he was made assistant professor of electrical engineering. In 1917-18 he carried on important research in submarine detection for a special board on submarine devices of the United States navy.

♦ ♦ ♦

FRED CLEMENTS has been awarded the Bessemer gold medal for this year by the Council of the Iron and Steel Institute in international recognition of services rendered the iron and steel industry. He is director and general manager of the Park Gate Iron & Steel Co. Ltd., Rotherham, England.

♦ ♦ ♦

DR. HEINRICH RIES is the recipient of the Joseph S. Seaman medal, and DAVID MCLAIN will receive the J. H. Whiting medal, the board of directors of the American Foundrymen's association has announced.

♦ ♦ ♦

JOSEPH A. ANGLADA, president of Angalada Motor Corp.; LOUIS SCHWITZER, president of Schwitzer-Cummins Co.; and ALEX TAUB, Chevrolet development engineer, are the new S.A.E. councilors, elected for the 1936-37 term.

♦ ♦ ♦

D. D. WILE holds the position of engineer in the newly established refrigeration division of Detroit Lubricator Co.

♦ ♦ ♦

LESTER BENSON, designer of the Clipper Ships now flying the Pacific, has been appointed factory manager for Bell Aircraft Co., Buffalo.

♦ ♦ ♦

OWEN D. YOUNG, chairman, General Electric Co., Schenectady, N. Y., recently was awarded the 1935 gold medal of fellowship by the Society of Arts and Sciences.

♦ ♦ ♦

C. A. RODMAN, formerly air conditioning engineer for Chrysler Corp., has joined Universal Cooler Corp. Before his affiliation with Chrysler he was chief refrigeration engineer of S. F. Bowser & Co.

♦ ♦ ♦

M. W. LINK has been named director of the research and development division of Crane Co. Assistant director is B. A. PARKS, and A. M. HOUSER is engineer of standardization.

♦ ♦ ♦

H. M. NORTHRUP, chief engineer, Hudson Motor Car Co., has been elected a director of his company. A. E. BARIT is the new president of Hudson, succeeding the late ROY D. CHAPIN.

♦ ♦ ♦

ROBERT S. HAMMOND is the new president of the Foundry Equipment Manufacturers' association. He is vice president of Whiting Corp., Harvey, Ill.

♦ ♦ ♦

DR. A. A. POTTER, dean of the schools of engineering, Purdue university, recently was made president of the American Engineering council for 1936-37, succeeding J. F. Coleman of New Orleans. He is past president of the American Society of Mechanical Engineers. A picture and brief biographical sketch of Dean Potter appeared in MACHINE DESIGN, Sept., 1932.

♦ ♦ ♦

JOEL C. CARPENTER recently joined the technical staff of Battelle Memorial Institute, Columbus, O., and has been assigned to the division of process metallurgy. WILBUR H. BACHMAN also is a new member of the staff, in the division of physical metallurgy.

♦ ♦ ♦

FRANK J. ZINK has resigned as associate professor of agricultural engineering at Kansas State College to become assistant to H. C. Merritt, general manager, tractor division, Allis-Chalmers Mfg. Co., Milwaukee. He will be engaged in research and development work.

♦ ♦ ♦

F. J. FITNESS, chief engineer of Reo Motor Car Co., Lansing, Mich., for the past two years, has been appointed works manager. He will continue to supervise the engineering department in addition to the manufacturing division.

♦ ♦ ♦

A. M. MACCUTCHEON, engineering vice president,, Reliance Electric & Engineering Co., Cleveland, has received the nomination for president of the American Institute of Electrical Engineers.

♦ ♦ ♦

BRENT WILEY recently was elected managing director of the Association of Iron & Steel Electrical Engineers. He was affiliated with Westinghouse for twenty-five years.

♦ ♦ ♦

FRED E. KLING, recently named assistant chief engineer of Carnegie- Illinois Steel Corp., Pittsburgh, has been associated with the Carnegie company for the past thirty-four years.

♦ ♦ ♦

CARL F. LOMB, vice president of Bausch & Lomb Optical Co., Rochester, N. Y., was honored as an educator when the Society of the Genesee held its annual dinner in New York recently. Seven hundred guests joined in a tribute to Mr. Lomb, chairman of the board of Mechanics Institute in Rochester. He has served on the directorate since 1910.

Obituaries

ALBERT F. SHORE, fifty-nine years old, inventor and prominent metallurgical engineer, died recently in New York. He was president of the Shore Instrument & Mfg. Co., and had been a recipient of the Elliott-Cresson medal from Franklin Institute. Of the many metallurgical testing instruments he invented, the best known is the scleroscope for determining the hardness of metals. Mr. Shore was a member of the American Society for Metals and had contributed to its meetings many monographs on the physical properties of metals.

♦ ♦ ♦

HENRY C. LOMB, son of the co-founder of Bausch & Lomb Optical Co., died recently in New York. He was a director of that institution. After graduating from the University of Rochester and Cornell university, he studied at the Universities of Berlin and Paris, specializing in mathematics and physics.

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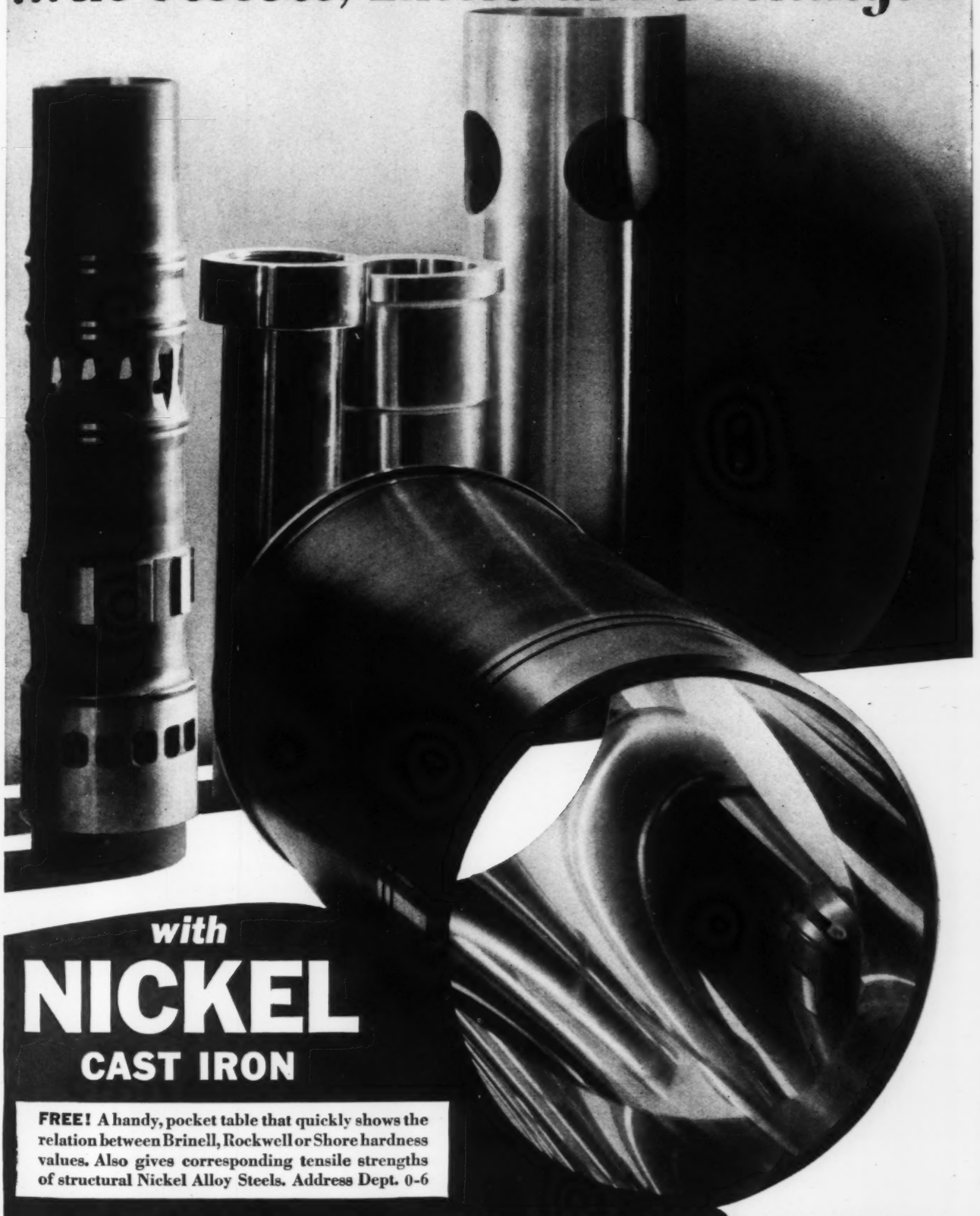

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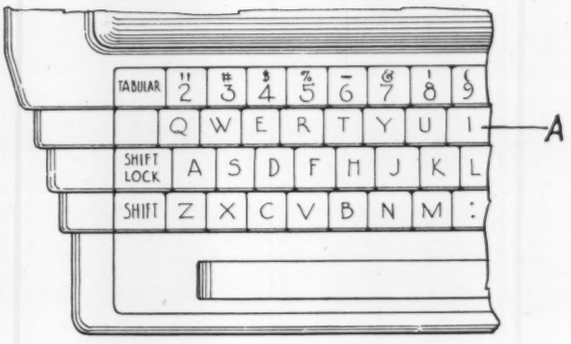
THE INTERNATIONAL NICKEL COMPANY, INC., 67 WALL ST., NEW YORK, N. Y.

Noteworthy Patents

KEYS constructed and arranged so as to afford a practically closed case for the interior mechanism of a typewriter have possibilities in designing for appearance. R. U. Jennings, Buffalo, has patented such a typewriter which could be advantageously constructed of plastic material. The keys are rectangular in shape, those in one row overlapping somewhat in a vertical plane the keys of the adjacent row. In this way their position provides a closed unit which will effectively guard the compartment beneath the keys against the entrance of dust and dirt.

Sketch *X, Fig.* 1, reveals how the stepped design of the frame corresponds to the stepped banks or rows of keys *A*. Each key is connected



X

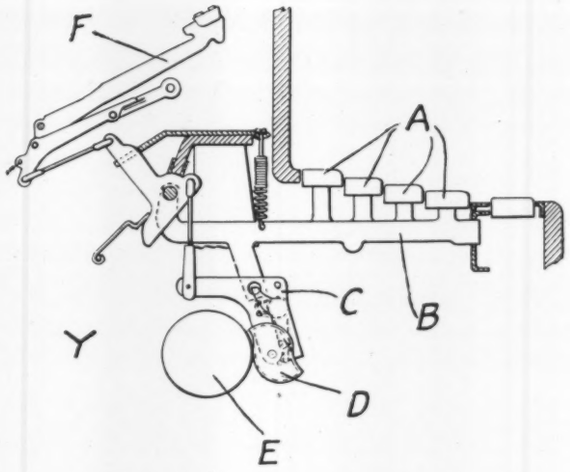


Fig. 1—Above—Rectangular keys positioned closely together provide closure and aid appearance of typewriter

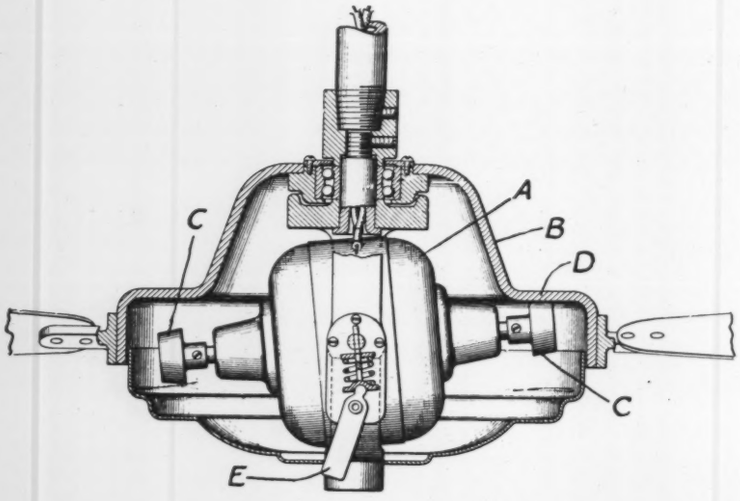


Fig. 2—Left—Tilting motor and friction drive are combined to provide reversible fan

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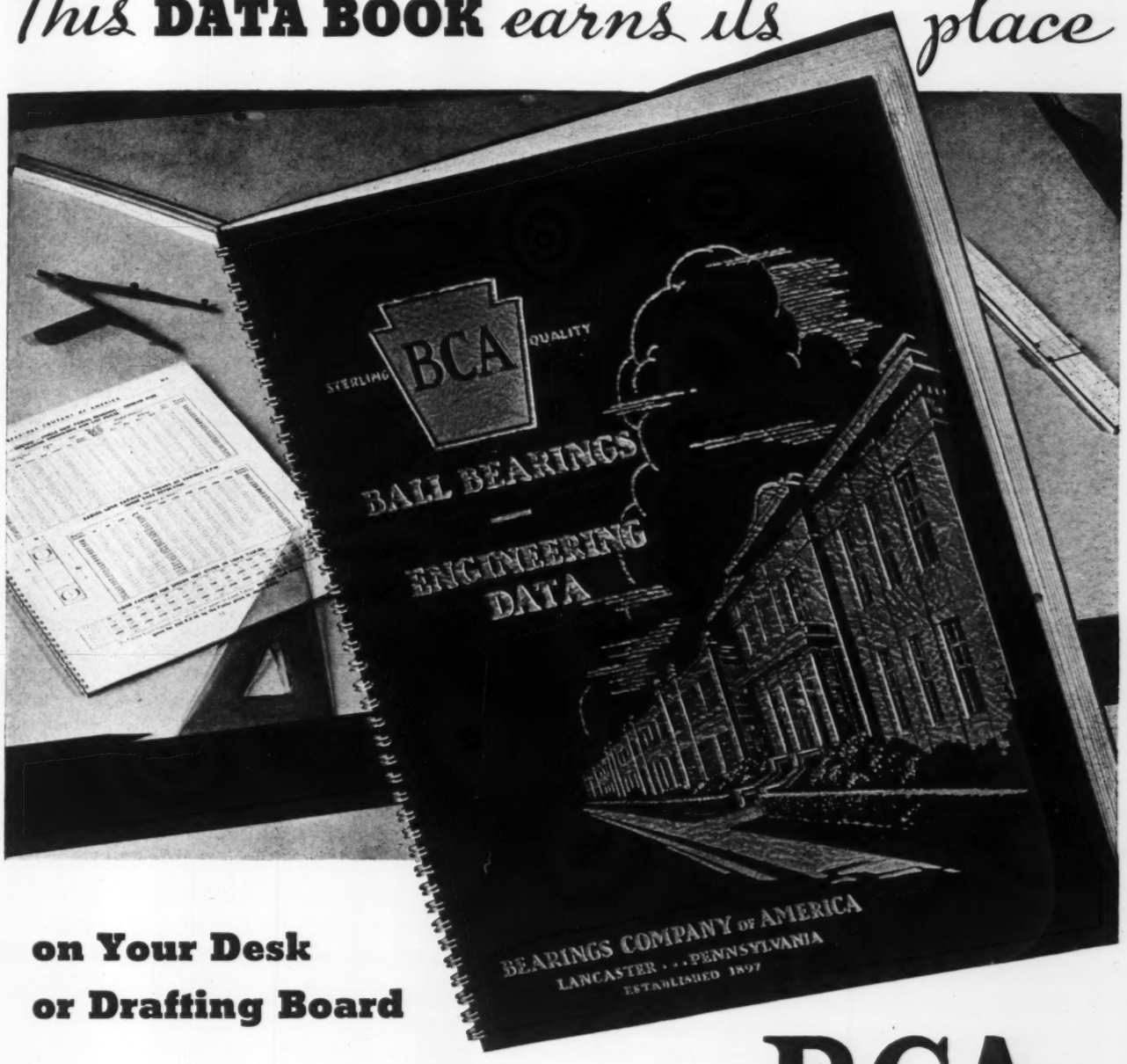

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BUSY executives, engineers and draftsmen will welcome this new, more compact and convenient Ball Bearing Data Book. It contains complete information on all sizes and types of ball bearings, arranged in the most convenient form for quick and handy reference. Among the many improved features is a new and easier method of figuring loads at any desired speed.

The man at the drawing board will especially appreciate the handy 8½" x 11" page size, with complete information on each type of bearing on one page. He also will like the Wire-o Binding which allows the book to fold back at any page and lie absolutely flat on the drafting board.

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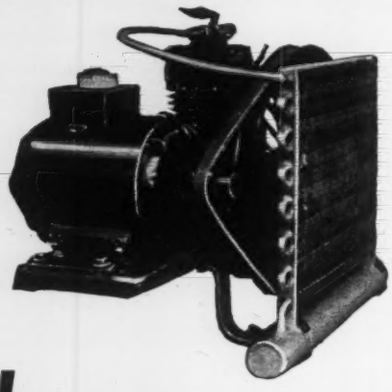


WAGNER MOTORS
are Well-Designed

Wagner motors conform to appliance and machinery manufacturers' demands for auxiliary equipment that harmonizes with the arrangement, utility, and construction of their equipment.

Every single item that has a definite bearing on the appearance of Wagner motors contributes to its mechanical efficiency. Drip-proof end-plates, for example (see Photo N445), protect the motor from falling dirt and liquids, and protect individuals from contact with moving parts. Ample ventilation is secured from openings located underneath the bearing housings.

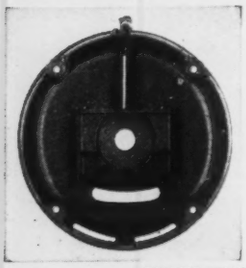


PHOTO N445

All parts and completed motors undergo careful and thorotests according to all N. E. M. A. specifications,—your assurance of reliable, quiet, trouble-free, quality motors. Photo K1261 shows a view of one of the test boards with a motor undergoing tests.

PHOTO K1261

Wagner Bulletin 177, which completely describes the construction features of Wagner small motors, will be sent upon request.

S635-5J

Wagner Electric

MOTORS
TRANSFORMERS
FANS
BRAKES

6400 Plymouth Avenue St. Louis, U. S. A.

through a bar *B*, sketch *Y*, to control a cam unit *C* carrying a cam *D* which is positioned, when the key is depressed, in operative relation to a power roller *E*. This roller is rotated continuously by an electric motor and when cam *D* is set it actuates type bar *F* through a mechanism covered in an earlier patent. No. 1,990,877 identifies the patent under discussion.

A REVERSIBLE drive for a ventilating fan can be obtained by employing the idea depicted in *Fig.* 2. This construction is covered by a recent patent granted to W. K. Skolfield and assigned to General Electric Co. Motor *A* is pivotally mounted in a frame inside a fan blade carrier *B*. The drive is effected through friction driving members *C* which contact annular track *D*. Since the two driving members are mounted on the same shaft they rotate in the same direction. Engagement being provided with diametrically opposed portions of a driven member such as the blade carrier *B*, the direction of rotation of this carrier depends upon which driving member *C* is in engagement with the track. Lever *E* is rigidly connected to the motor supporting frame and affords the means by which the motor is tilted to change the direction of rotation of the fan blades. This patent is identified as No. 2,027,844.

LONG bearing portions for a wristpin on the pressure side of the pin are obtained in a newly patented construction that avoids any tendency of this continuous bearing to push out

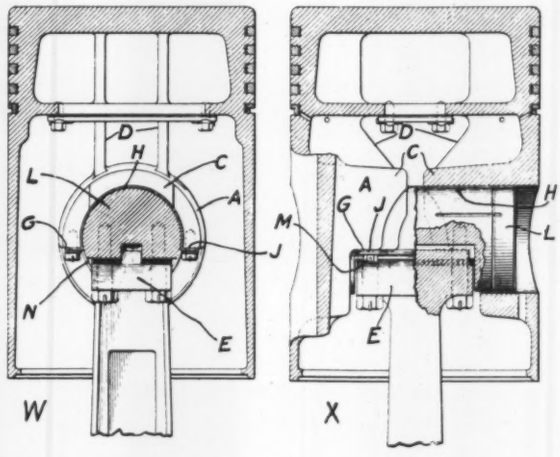
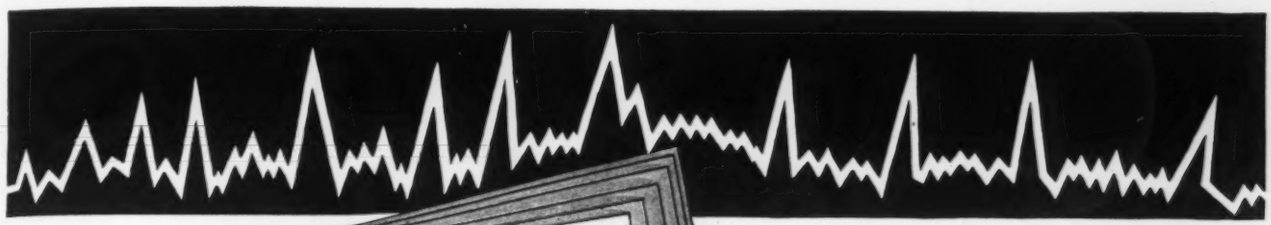


Fig. 3—Increased length and area on the pressure side of the wrist pin are provided in this design

the sides of the piston. The wristpin bearings comprise opposed hubs *A*, *Fig.* 3, drawings *W*, *X*, that extend inwardly from the walls of the piston. Upper or pressure side portions *O* are braced by webs *D*. This design affords full bearing area on the pressure side of the pin and



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yet if the bearing should heat up and expand the hubs, expansion would be taken up between the inner ends of the hubs.

The lower portions of the hubs are shorter than the upper or pressure portions, their inner ends being spaced a greater distance from each other to allow head *E* of the connecting rod to be received between them. Edges *G* are machined to form seats for the ends or flaps of a sheet bushing *H*. This part is preferably stamped out of sheet metal and rolled into form, being assembled with the piston by sliding the bushing longitudinally through the hubs until flaps *J* are aligned with seats *G* on the hubs. In this position the ends of the bushing, which are split, are located within the outer ends of the hubs. Wristpin *L* then is inserted endwise into the bushing, after which portions *J* are bent over seats *G* and secured in position by washer plates and bolts.

Wristpin *L* is of the same diameter throughout and for purposes of connection with head *E* is cut away to provide a flat seat for connecting rod head *E*. Hewitt A. Gehres is the inventor and Cooper-Bessemer Corp., the patentee. Number of the patent is 2,027,035.

BEAT-FREQUENCY of the hammer of an alarm clock is controlled automatically by the drive spring in a design recently patented by W. E. Porter for the New Haven Clock Co. When the alarm train commences to operate, actuating finger *B, Fig. 4X,* is in registration

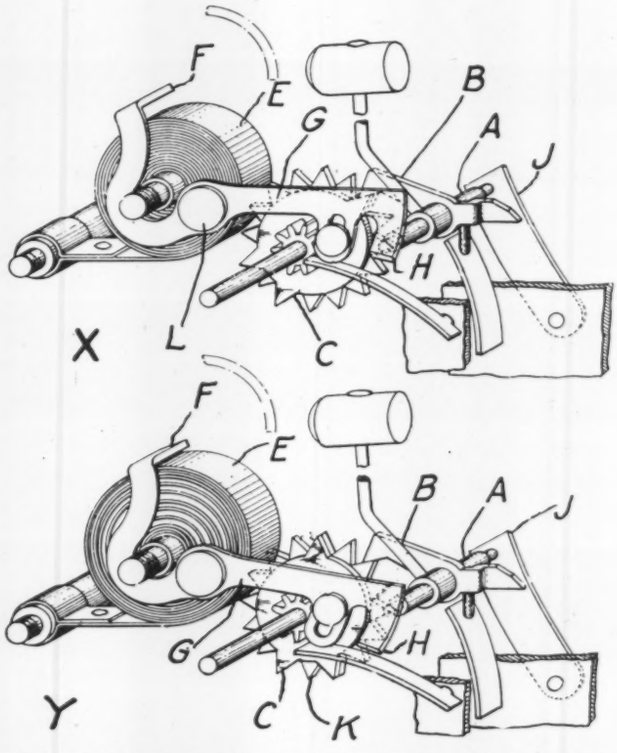
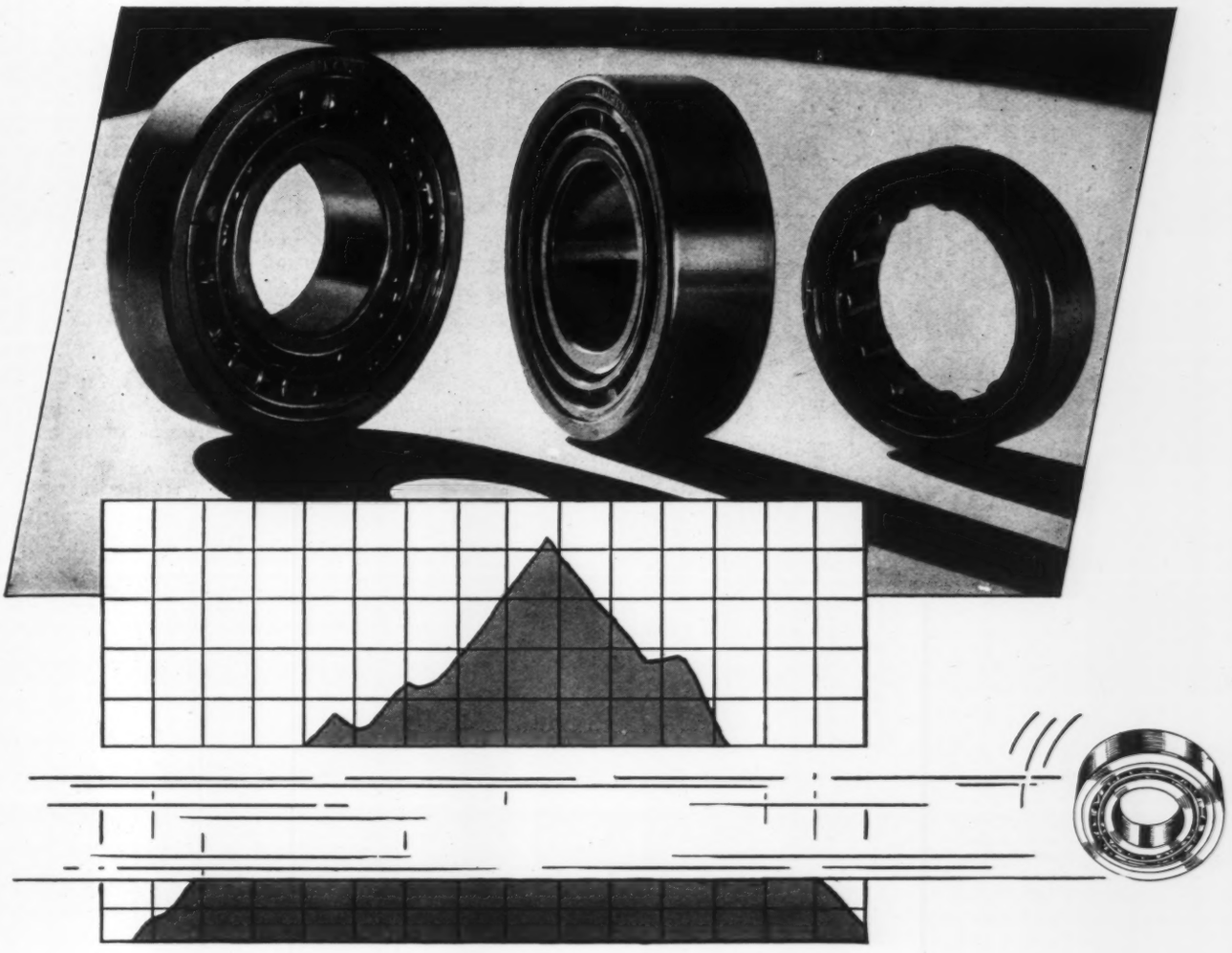


Fig. 4—As the clock spring expands in diameter it engages a finger to speed the alarm



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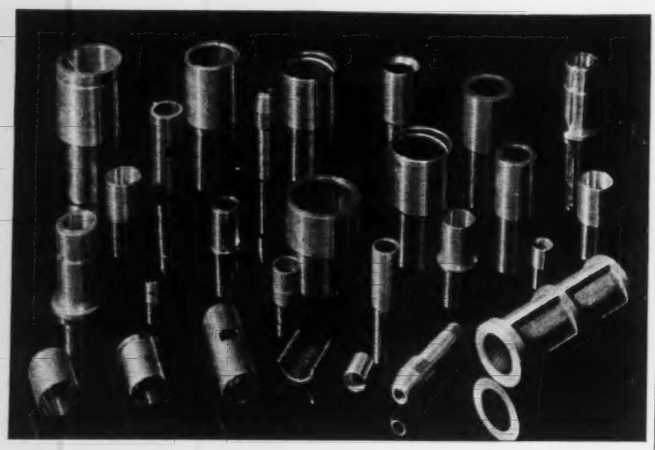
Peak loads may mark their presence on a graph . . . but never on a Hyatt Roller Bearing. For Hyatts are built to take loads without perceptible wear and with minimum care. Made of impregnable steel, machined and ground to microscopic tolerances, it's the job of these sturdy bearings to endure the merciless punishment of speed, stress, and shock while protecting related parts. Isn't it easy to realize, then, why users find Hyatts so vital to the lifestream of their products? Doesn't it also emphasize why Hyatt Roller Bearings should be specified . . . everywhere? Hyatt Roller Bearing Company, Newark, Detroit, Chicago, Pittsburgh, San Francisco.

H Y A T T

ROLLER BEARINGS

PRODUCT OF GENERAL MOTORS



COST . . . *so little mean so* . . . MUCH

IN COMPARISON, the cost of the bearings is perhaps the smallest item in your product. . . . Yet no other part carries such a great responsibility in the final performance of the machine. Consequently it's just common sense to insist on the highest quality possible.

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Why not take advantage of our more than a quarter of a century exclusive bearing experience? We maintain a competent staff of Engineers and Metallurgists to give you all the assistance and advice necessary to real bearing performance. We will consider it a favor to work with you . . . . entirely without obligation.

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with the three-toothed primary alarm actuating wheel *C*, with the result that the hammer is operated only by these three teeth for each revolution of the wheel thus giving a "slow" alarm.

As spring *E* expands in the course of expending its stored energy, the periphery of its outer convolution will engage operating finger *F* (drawing *Y*) and rock shift lever *G* about its fulcrum *L* in a counterclockwise direction, causing cam finger *H* to slide downwardly over the rear end of hammer shaft *A* and thus cam it, together with the parts carried thereby, forwardly against tension of spring *J*. By this movement actuating finger *B* carried by the shaft will be brought into alignment with the more numerous teeth of the secondary alarm actuating wheel *K*, whereupon immediately the hammer will be actuated at more frequent intervals than it had been previously by the lesser toothed primary wheel *C*.

Number of this patent is 2,020,738.

Other Recent Patents in Brief

SLUG CASTING MACHINE—2,035,076—Eighteen claims. George P. Kingsbury. Assigned to Mergenthaler Linotype Co., New York.

FABRIC PRINTING MACHINE—2,035,137—Seven claims. Isaac Magath. Assigned to Uni-Print Corp., New York.

COIN COLLECTOR—2,035,280—Eight claims. Oscar A. Shann. Assigned to Bell Telephone Laboratories Inc., New York.

COPPER STEEL ALLOYS—2,035,392—Five claims. R. H. McCarroll and Gosta Vennerholm. Assigned to Ford Motor Co., Dearborn, Mich.

TIRE BUILDING MACHINE—2,035,422—Six claims. W. J. Breth and M. L. Engler. Assigned to General Tire & Rubber Co., Akron.

STOKER—2,033,919—Fourteen claims, Warren D. Burton. Assigned to Combustioneer Inc., Goshen, Ind.

BISCUIT UNLOADER—2,034,108—Thirteen claims. Eugene F. Marresford. Assigned to National Biscuit Co., New York.

STRAND TWISTING APPARATUS—2,034,268—Thirteen claims. Roland R. Nydegger. Assigned to Western Electric Co., New York.

COUPLING OR CLUTCH MECHANISM — 2,025,108 — Seven claims. Emerson E. Hogg. Assigned to Aluminum Co. of America, Pittsburgh.

VOTING MACHINE—2,025,164—Two claims. Alvin N. Gustavson. Assigned to Automatic Voting Machine Corp.

SHEAR—2,025,418—Four claims. Carl E. Moore. Assigned to American Sheet & Tin Plate Co.

EXTENSION RING FOR CLAY PRESSES—2,025,419—Two claims. John H. Moren. Assigned to Patton Clay Mfg. Co., Patton, Pa.

FLASH REMOVER—2,025,421—Fifteen claims. Herbert C. Rippel. Assigned to Republic Steel Corp., Youngstown, O.

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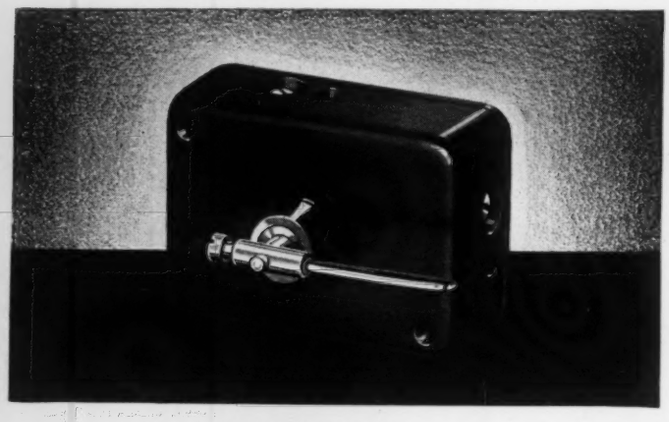
Penton Building, Cleveland, O.

This illustration of the Pilot Switch is actual size



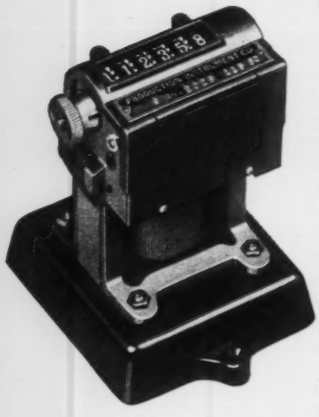
½ OUNCE *pressure operates this New* PILOT SWITCH

★ Extreme sensitivity and small size (1⅝ x 1⅛ x ⅝) distinguishes the Type ES-9 Pilot Switch, yet it is a durable and dependable switch rated to make and break ½ ampere, A.C., or ¼ ampere, D.C., on inductive, resistance, or lamp loads.

The case is high-grade molded bakelite, and there are only six other parts. Phosphor bronze contact spring, coin silver contact points, and bronze shaft bearing are features of substantial construction that enable this Pilot Switch to withstand 15 million operations at 1800 cycles per minute with negligible wear and no change in its perfect operating condition.

The Pilot Switch may be had to operate right or left hand, open or closed circuit, with reciprocal or rotary motion, and with any position of lever arm. Make and break position may be accurately adjusted.

There are literally hundreds of uses requiring an accurate positive electrical contact where the Type ES-9 Pilot Switch solves the problem ideally. In connection with Type EC Electric Counters, any type of light weight or fragile articles can be accurately counted, giving valuable production records.



TYPE EC ELECTRIC COUNTERS are operated by any electrical impulse, direct from any type of switch, photo-electric relay, or periodic circuit. They deliver an accurate production count, often under circumstances where any other exact record would be impossible. Production Instrument Company Electric Counters are high-grade precision instruments in every detail of their design and construction, built to withstand continuous operation with unvarying accuracy. They use less power than other types of electrical counters.

Write for bulletins describing the new Type ES-9 Pilot Switch, Type EC Electric Counters, and Switches of larger capacity.

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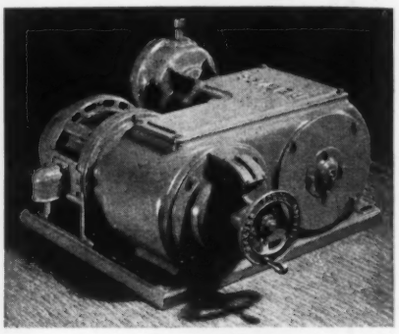
Accurate Counting and Recording Devices

NEW *Materials and Parts*

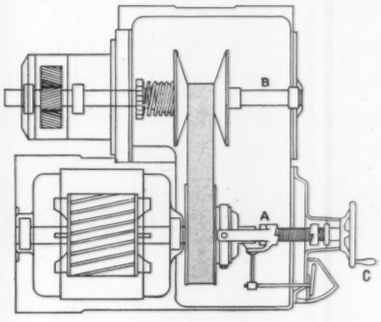
Combines Motor and Variable Speed

COMBINING in a compact, self-contained enclosure any standard make of constant speed motor, variable speed control mechanism, and (where required) speed reduction gears, Reeves Pulley Co., Columbus, Ind., has developed the Vari-Speed Motodrive. Speed variation as provided by the Motodrive is infinite between predetermined limits. Merely by turning a convenient handwheel any desired speed within the range is made smoothly and quickly available. A dial indicator registers speeds on a scale calibrated from 1 to 6.



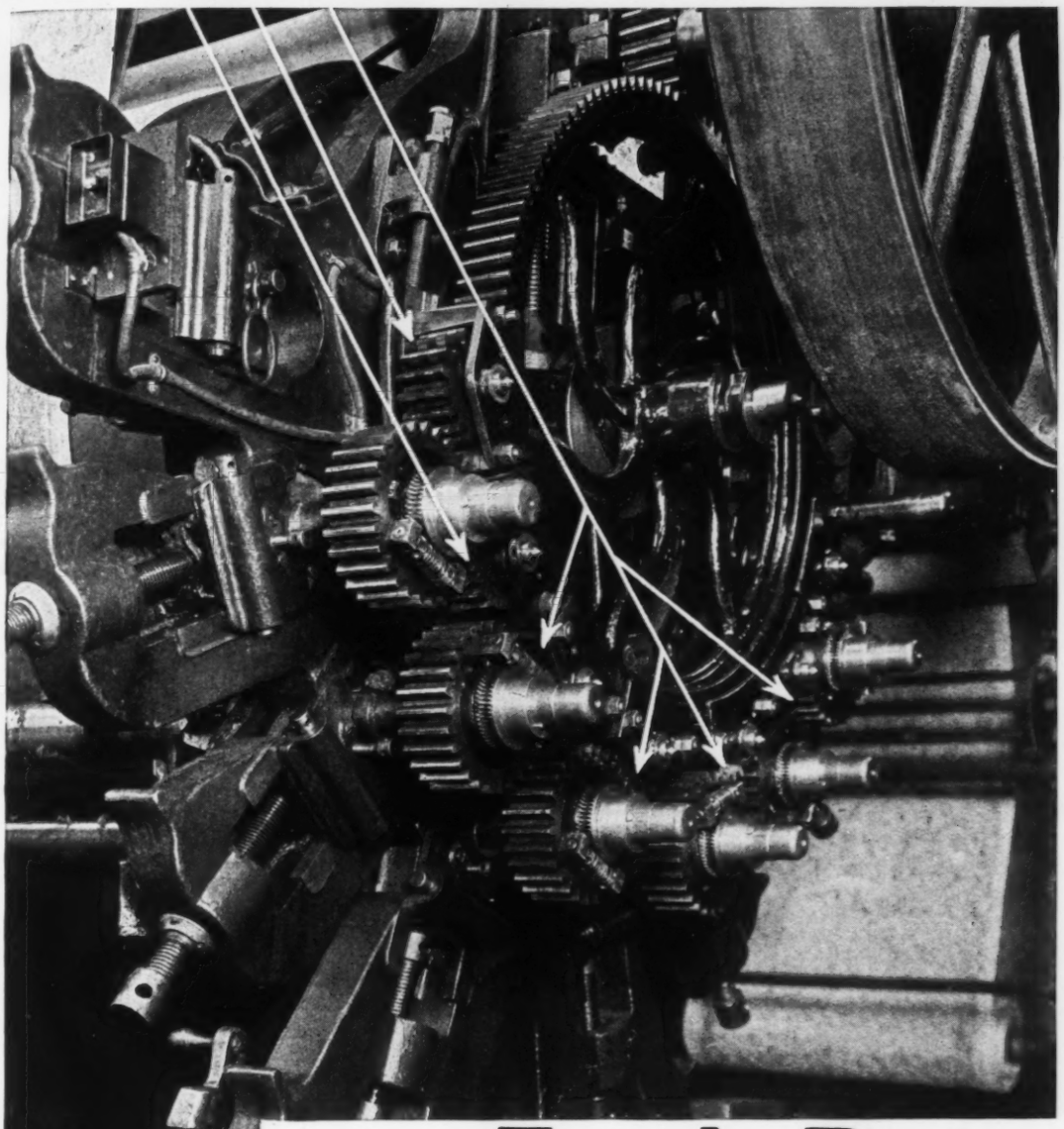
Motor, variable speed control mechanism and speed reduction gears, where required, are combined in a single unit

The new unit combines features of both the variable speed transmission and the vari-speed motor pulley made by the company. It utilizes the principle of a V-belt running between two sets of cone-faced disks which are adjustable in diameter and mounted on parallel shafts. One shaft receives power at constant speed from the motor and the other shaft transmits power at infinitely adjustable speeds to the driven machine. Features of the unit include a system of ventilation to maintain uniform temperatures of motor and variable speed mechanism, and positive lubrication with conveniently located force feed fittings. The variable speed shaft



Variable speed shaft, with reduction gears, may be extended on either side of the mechanism

FORMICA IDLER GEARS



-in a Textile Drive

SEVERAL Formica idler gears were used by Rice, Barton & Fales of Worcester, Mass., in the drive, on which they hold patents, for this printing machine.

There has been a steady drift toward Formica gear drive because of its silence, its simplicity and few moving parts, light weight and great durability.

Formica is a friend to the machinery salesman, because his smoothly and silently operating equipment is easier to sell. It greatly helps the maintenance man to keep his machinery operating sweetly and smoothly.

The gear cutters named can provide promptly Formica gears in large or small quantities.

THE FORMICA INSULATION COMPANY
4640 Spring Grove Ave., Cincinnati, O.

FORMICA

NON-METALLIC GEARS

FORMICA Gear Cutters

The Akron Gear & En'g Co.
Akron, Ohio

Farrel-Birmingham Co., Inc.,
Buffalo, N. Y.

Slaysman & Company
Baltimore, Md.

Harry A. Moore
Bangor, Me.

The Union Gear & Mch. Co.
Boston, Mass.

The Atlantic Gear Works
New York City

Chicago Rawhide Mfg. Co.
Chicago, Ill.

Perfection Gear Company
Chicago, Ill.

The Mechanical Specialty
Mfg. Co., Chicago, Ill.

Merkle-Korff Gear Co.
Chicago, Ill.

Chicago Gear Company
Chicago, Ill.

The Cincinnati Gear Co.
Cincinnati, O.

The Horsburgh & Scott Co.
Cleveland, O.

The Stahl Gear & Machine
Co., Cleveland, O.

The Master Electric Co.
Dayton, O.

The Adams Company
Dubuque, Ia.

The Ferguson Gear Co.
Gastonia, N. C.

Hartford Special Mchny. Co.
Hartford, Conn.

Beaty Machine Works
Keokuk, Ia.

The Generating Gear Co.
Milwaukee, Wis.

Badger State Gear Co.
Milwaukee, Wis.

Precision Machine Co.
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E. A. Pynch Co.
Minneapolis, Minn.

Joaquin Alemany Lopez
Havana, Cuba

New Jersey Gear & Mfg. Co.
Newark, N. J.

Prager, Inc.
New Orleans, La.

J. Morrison Gilmour
151 Lafayette St.
New York City

Sier-Bath, Inc.
New York City, N. Y.

E. M. Smith Machine Co.
Peoria, Ill.

The Eagle Gear & Mch. Co.
Philadelphia, Pa.

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Supply Co., Pittsburgh, Pa.

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Perkins Machine & Gear Co.
Springfield, Mass.

Winfield H. Smith, Inc.
Springbille, N. Y.

Alling Lander Company
Sodus, N. Y.

Charles E. Crofoot Gear
Corp'n, South Easton, Mass.

Arlington Machine Co.
St. Paul, Minn.

Farwell Mfg. Co.
Toledo, Ohio

Diefendorf Gear Corp.
Syracuse, N. Y.

Worcester Gear Works
Worcester, Mass.

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Not a single bearing is missed when the Farval Centralized System of Lubrication is installed on machine equipment. From the central station, lubricant is conducted under high pressure to positive measuring Valves located at the bearings throughout the System. These adjustable Valves deliver lubricant in the exact, measured quantities required, each time the System operates.

Farval has pioneered for years in methods of scientific lubrication for industrial plant equipment. Today's Farval Systems are based upon the most advanced practices of engineering and design, with a great background of experience gained from service to every principal division of industry, comprising thousands of successful installations.

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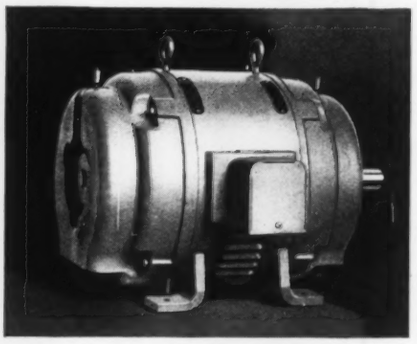
FARVAL
CENTRALIZED SYSTEM OF LUBRICATION
Special Delivery to Every Bearing

may be extended on either side of the unit as required.

The drive is available in two designs—horizontal and vertical. Each design is built in four sizes which take motors from ¼ to 7½ horsepower capacities and which cover speed ratios from 2:1 to 6:1. Reduction units of helical gear type in ratios up to and including 189:1 may be incorporated in the drive. In different combinations of sizes, ratios and reduction gears, output speeds ranging from a minimum of 1.35 RPM to a maximum of 3480 RPM may be obtained. Units may, within certain limitations, be mounted on wall, floor or ceiling, or may be mounted directly on the driven machine.

New Motors Are Splashproof

A NEW complete line of splashproof squirrel cage motors in all ratings from ½ to 200 horsepower for constant and multispeed, continuous or intermittent duty in all voltages and cycles and for any torque and starting current are being introduced by Imperial Electric Co.,

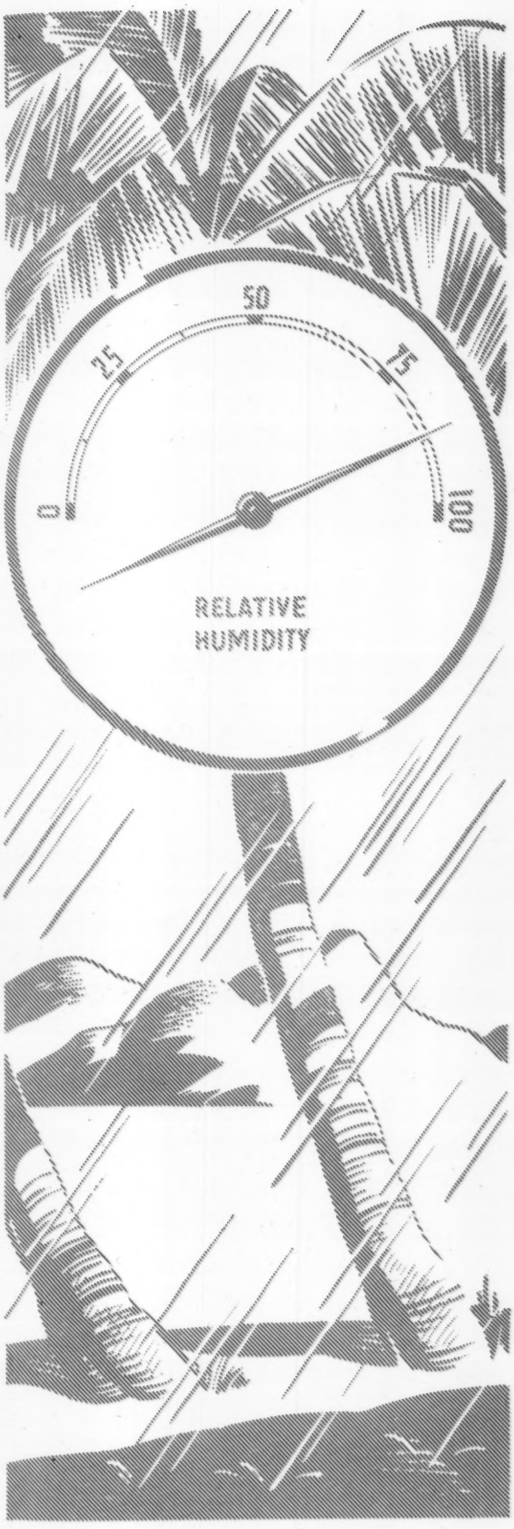


Air is taken into splashproof motors through small openings in the bottom of the end brackets

56 Ira avenue, Akron, O. The construction of these motors provides protection to the inner parts from splash or spray and yet permits proper ventilation by small openings in the bottom of the end brackets for the air intake, and louvres in the frame cover underneath the motor for the air exit.

Load Cushions Are Free Floating

A NEW type, nonlubricated heavy duty flexible coupling, designated as L-R type "W," is now being manufactured by Lovejoy Tool Works, 5018 West Lake street, Chicago. As shown in the accompanying illustration, the individual load cushions of the coupling are free floating between the metal jaws and rest upon



Century Repulsion Start Induction Brush Lifting, Type Motor

In Damp SURROUNDINGS *and Humid* CLIMATES

Century Repulsion-Start Induction Single Phase Brush-Lifting Open Type Motors keep-a-running in damp surroundings and humid climates, in domestic and foreign installations—because

1st. The foundation insulation is right.

2nd. The winding and insulation is thoroughly saturated with insulating paints and varnish.

3rd. Vital metal parts receive rust-preventing treatment.

Sizes, 1/8 to 40 Horse Power.

Totally-Enclosed and Splash-Proof Motors can be furnished where the job requires regular washing down with a hose.

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They are ready to co-operate with your own designers whenever you wish, to help work out your problems of motor application. They are doing such work successfully for well known manufacturers in almost every branch of industry. In most cases the problem can be solved with a standard Diehl motor because of the broad scope of sizes and types available. Even where a special motor may at first be thought necessary, the need often can be met by slight variations from a Diehl motor standard. If a special motor is essential, Diehl has every facility for its development and production. In all cases, a Diehl motor creates confidence in the driven machine and builds goodwill by long, trouble-free service.

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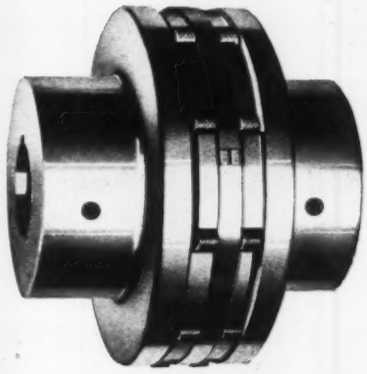
Electrical Division of THE SINGER MANUFACTURING CO.
ATLANTA BOSTON CHICAGO DALLAS NEW YORK PHILADELPHIA

the central hub, being firmly secured in place by a spiral steel spring. Cushions are free to move and adjust themselves instantly to any momentary position of the jaws. With this method of retaining the load cushions, larger hubs are possible, and the design likewise permits greater load carrying surfaces and increased load carrying capacity. There is no metal to metal contact, and no wear on the iron or steel jaws.

In operation, one-half of the cushions are idlers (except on reversing loads), hence there is always a set of new cushions in the coupling.



Cushions in flexible coupling adjust themselves to any momentary position of the jaws

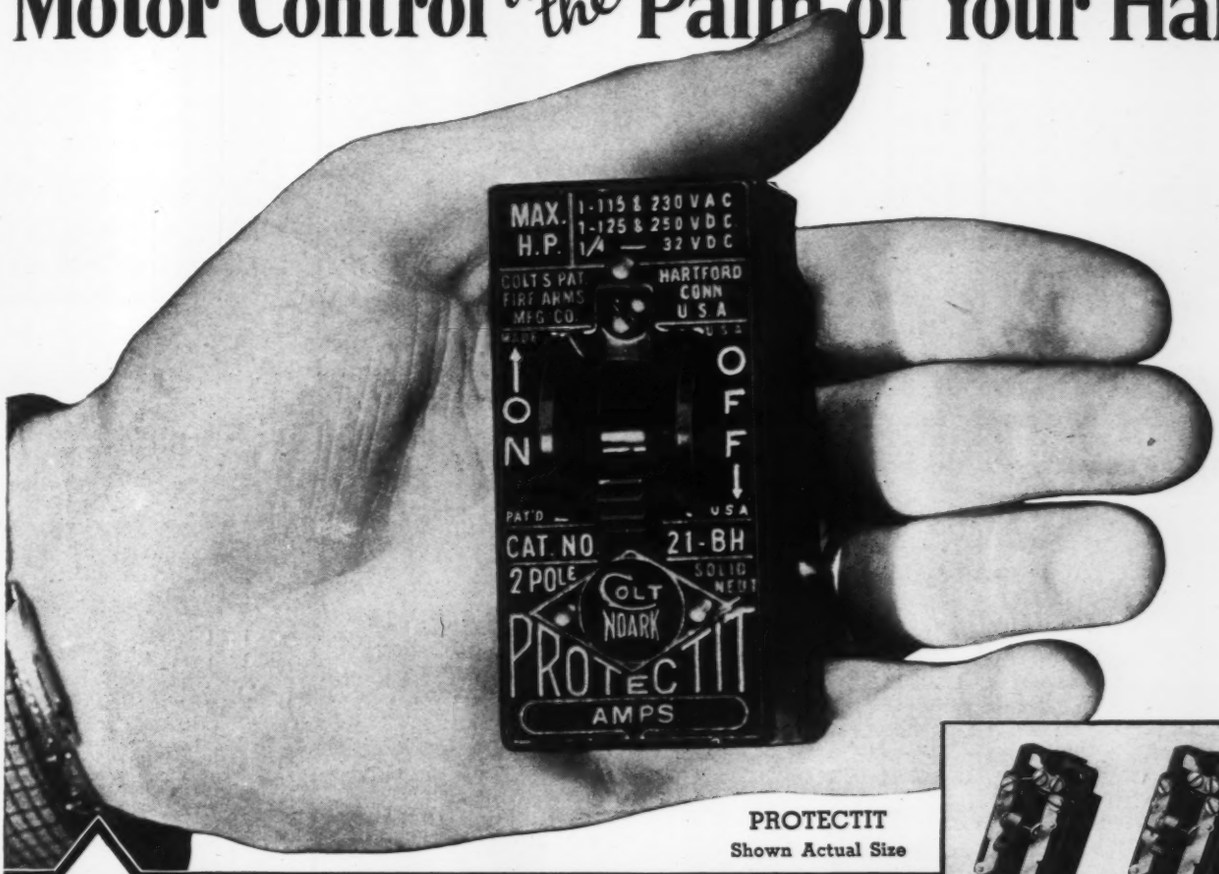
There are three types of resilient cushioning materials available: Metalflex—a high grade brake lining material used for heavy shock loads as on excavating machinery, steel mill equipment, and similar machines; Leather load cushions—oak tanned belting leather for use on sustained loads and in applications with greater misalignment; Multiflex cushions — a rubber duck fabric vulcanized under pressure, for use on fluctuating loads and where high resilience is required. The couplings are also furnished with one body made as a flange for bolting to the flywheel. This design reduces overall length of the coupling by one-third.

Enlarges Bearing Line

GREASE-SHIELD ball bearings of improved construction are now being supplied in an increased range of sizes by Fafnir Bearing Co., New Britain, Conn. These bearings are equipped with single or double metal side-shields (sometimes known as plate seals) to aid retention of the lubricant and to exclude dirt and foreign matter. For applications in moderate service, these self-contained shields simplify problems of housing design. In more severe service they supplement additional covers, grease baffles, etc.

In the "single-shield" (D type) design a steel stamping is fastened securely to the bearing

Motor Control *in the* Palm of Your Hand

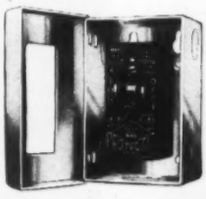


PROTECTIT
Shown Actual Size

COLT NOARK PROTECTIT

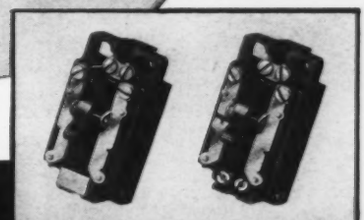
The New Auxiliary Circuit Breaker with a thousand uses!

The PROTECTIT is the newest COLT-NOARK development—a compact, simple switching unit that also provides automatic overload protection. Rugged in construction—built to stand up under continuous operation—and designed to protect motors up to 1 H. P. against damaging overloads. The PROTECTIT is designed for installation on washing machines, electric refrigerators, oil burners, and other electrical appliances . . . and for operating and protecting small motors on industrial machines and tools.

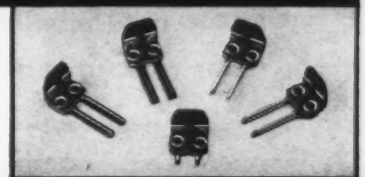


***PROTECTIT** in steel cabinet. Flush or surface mounting.*

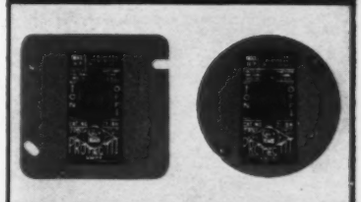
Two types are available—Type "B" with fixed ampere rating and Type "BH" adapted for using any one of nineteen differently rated heaters. The switching is dualbreak—and automatic overload protection is accomplished by a bi-metallic latch. The Toggle type operating mechanism is unusually simple and the handle entirely trip free. The PROTECTIT is completely enclosed in a rugged, attractive molded casing.



Type "B" PROTECTIT shown above on the left. Type "BH" on the right. Covers removed.



5 of the 19 differently rated heater elements available for Type "BH" PROTECTIT.



Showing the adaptation of PROTECTITS to standard 4" square and round outlet boxes.

Send for full information and catalog description.

COLT'S PATENT FIRE ARMS MFG. CO., ELECTRICAL DIVISION HARTFORD, CONN.
Boston, New York, Chicago and Philadelphia. H. B. Squires Co., Pacific Coast Representative

1836 COLT 1936

COLT-NOARK

SWITCHES - MOTOR STARTERS - FUSES

100 Years of Manufacturing Experience is back of Every Colt Built Product

DESIGN ON PARADE

Through the centuries design has moved forward. Often hated, frequently fought, design progress could not be stopped.

Today the tempo has quickened. The parade doesn't wait for laggards!

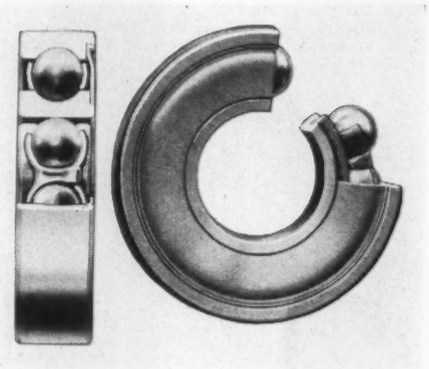
This parade is pictured in the pages of *Machine Design*. Every article is a record of progress from which the design engineer can adapt ideas to his own problems.

From the more than 6200 manufacturers of machines, from the thousands of makers of parts, materials and process equipment, from practicing engineers and the laboratory, the latest developments are brought to your attention.

Short, pertinent design topics are covered each month under the heading "Scanning the Field for Ideas."

Watch for these developments!

outer ring on one side, protruding into a rabbet on the end of the inner ring with but a few thousandths of an inch clearance. A recent improvement in this construction has shortened this rabbet so that less of the inner ring is cut away.



Special shields used with ball bearings assist in retention of lubricant

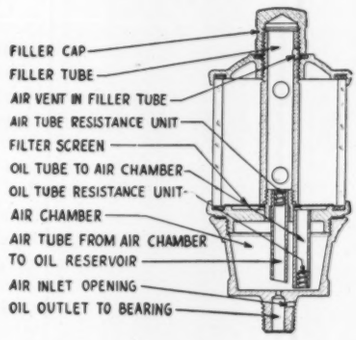
The shield itself is completely within the plane of the face.

Both this single-shield and the double-shield types are being offered in a widened range of sizes. More than 50 sizes are available in the single-shield type while twenty sizes are now available in bearings of the double-row single-shield type.

New Oilers Regulate Flow

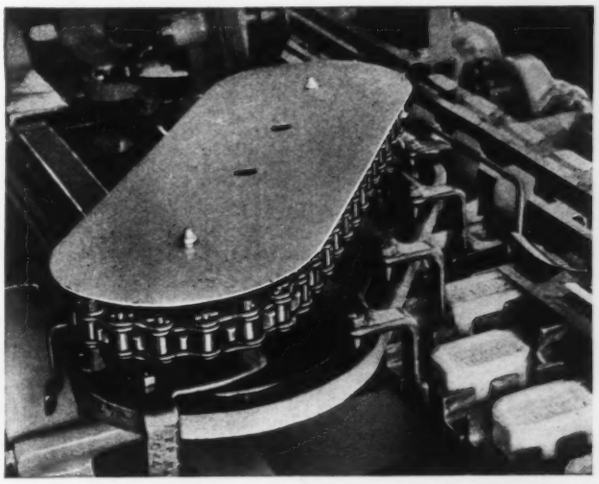
TWO NEW types of oil cups which combine the principles of sight feed oiler development with features that are distinctly new are now being produced by Alemite Corp., Chicago,

Expansion of air in new oil cup assures a constant, slow flow of lubricant to the bearing



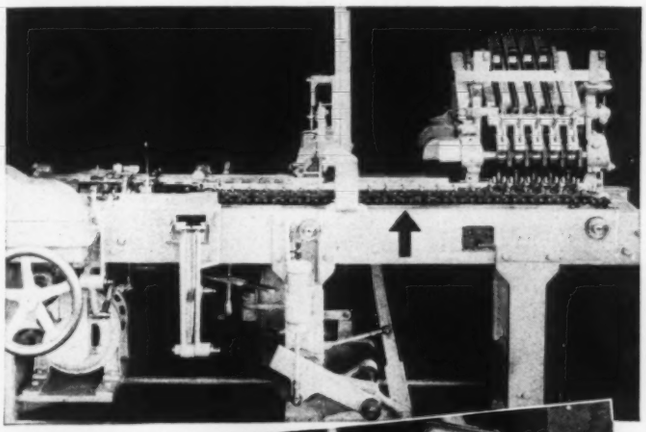
Ill. Of these two items, the more unique is the thermatic oil cup. Where a constant, slow flow of oil is desired, this cup affords more bearing protecting than is provided by conventional types. It operates simply by the expansion of air due to the normal increase in temperature of a

Accuracy of Timing Essential to High Speed Automatic Machinery

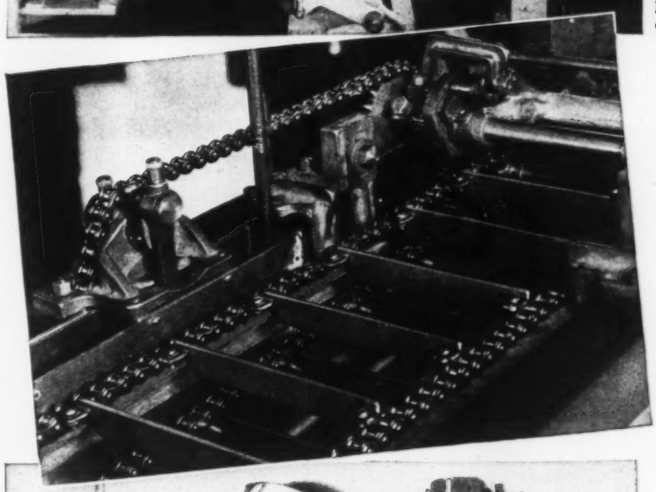


Perfect timing and coordination of the movements of the cakes of soap and the packages into which the soap is placed—are obtained on this machine by means of Diamond Chain.

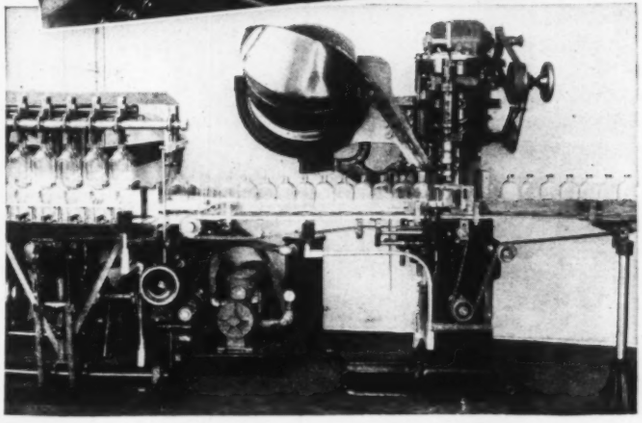
DIAMOND ROLLER CHAIN



Accuracy of timing and conveying is necessary here too—razor blades are counted, tucked in cartons at the rate of 200 cartons per minute. Diamond Roller Chain facilitates the design and insures long, dependable, operation.



Diamond for drive—and with special attachments for conveyor—governs the hourly production of this machine.

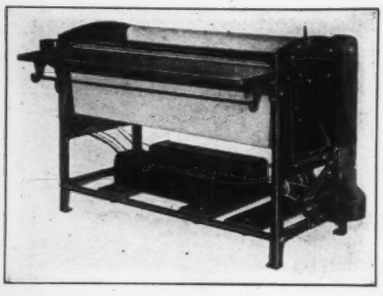


Diamond Chain employed by the builders of this bottle vacuum cleaning and filling machine, for conveying, driving, and timing operations.

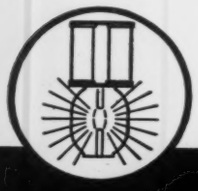
BESIDES such timing drives as on internal combustion gasoline and Diesel engines where Diamond Chains are so widely used—high speed production machinery requires similar accuracy of timing and coordinating the various motions.

Because of the extreme timing accuracy—the proven long life—almost 100% efficiency—and positiveness, Diamond Chains have been widely adapted by designers and builders of the highest grade of machinery for four decades . . . And users have come to look upon the "Diamond" trade mark on the chain as good evidence of the quality of the machines they buy . . . DIAMOND CHAIN & MFG. CO., 435 Kentucky Avenue, Indianapolis, Ind. *Offices and Distributors in Principal Cities.*

NEW . . . . . .
. . . EFFICIENT
•
PARAGON SC BLUE PRINTING MACHINE
•



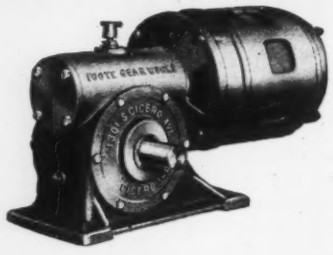
Paragon-Revolute introduces to the drafting room of moderate size its newly designed, low priced Model SC Printer, a 42" continuous printing, horizontal unit equipped with either two or three mercury vapor lamps.



May we mail complete literature and prices on this new machine that brought in a single order for fifty complete units? No obligation to you!

Paragon-Revolute Corporation
77 South Ave., Rochester, N.Y.

Brad Foote Line
MOTORIZED SPEED REDUCERS



incorporate a patented feature in the method of mounting motor on the reducer. This mounting is used in all sizes and styles. Mounting feature makes possible the disassembly of motor from reducer without disturbing or detaching of the reducer proper. It further provides free floating of the motor shaft and eliminates the possibility of oil entering the motor.

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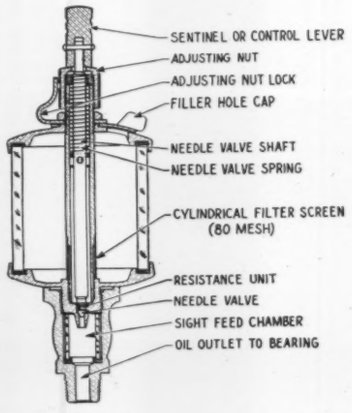
Ask for Book No. 5.

FOOTE GEAR WORKS, INC.
1301-G SOUTH CICERO AVE. CICERO, ILLINOIS

running bearing. There are no moving parts in this cup. Air expansion forces the oil from the bottom of the air chamber, and that supply is replaced from the cup reservoir by gravitational action. An inlet in the base of the cup admits sufficient air to maintain pressure on the oil. The air vent in the filler tube is so placed as to prevent dirt getting into the cup and into the lubricant.

The second new cup, the Microflow cup, is particularly adapted to bearings which require a



A continuous flow of oil in small, adjustable quantities is possible in unit which permits fine adjustments

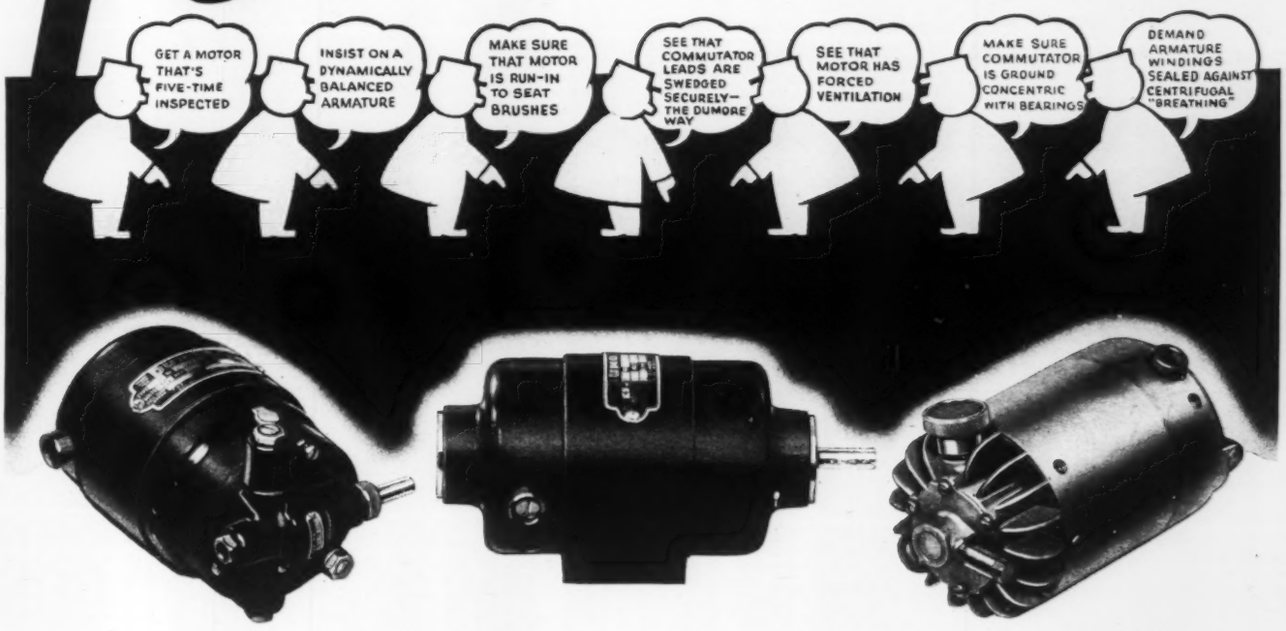
continuous flow of oil in small, adjustable quantities. It is fitted with an entirely new device, a resistance unit which permits a fine adjustment of oil flow and assures positive operation by preventing clogging. The large opening in the discharge valve assures an unhampered flow of oil, oil which has been strained of foreign particles by an 80-mesh screen. The grooved cylindrical plug, through which the oil must pass to reach the valve, can be adjusted to such a degree that the flow of oil can be made extremely minute, yet constant.

Cams Regulate Switch Action

REPEATING interval timers, compact units which may be adapted to any time sequence of open and closed circuits over time cycles of seconds, minutes or hours, in a new design known as Jewel No. 11, are being offered by Walser Automatic Timer Co., Graybar building, 420 Lexington avenue, New York. The new model, shown herewith, is the first synchronous motor powered timer in the company's line. Two or more adjustable cams, mounted on a drum, are rotated by the self-starting motor through reduction gears to obtain the time cycle required. Frequency of contact is a product of the speed per revolution and the number of cams on the drum.

Cams are easily adjusted to obtain varying

HOW TO GET MORE *Power Hours* FOR YOUR MONEY


GET A MOTOR THAT'S FIVE-TIME INSPECTED
INSIST ON A DYNAMICALLY BALANCED ARMATURE
MAKE SURE THAT MOTOR IS RUN-IN TO SEAT BRUSHES
SEE THAT COMMUTATOR LEADS ARE SWEDGED SECURELY—THE DUMORE WAY
SEE THAT MOTOR HAS FORCED VENTILATION
MAKE SURE COMMUTATOR IS GROUND CONCENTRIC WITH BEARINGS
DEMAND ARMATURE WINDINGS SEALED AGAINST CENTRIFUGAL "BREATHING"

Don't just buy an ordinary motor . . . It is important to consider the *power* application . . . starting torque . . . gear drive, belt drive, worm drive, chain drive . . . direction of shaft rotation . . . multi-speed or uniform speed . . . constant or fluctuating load . . . presence of moisture, steam or corrosive gases . . . methods of control . . . reversals under load or no load . . . special mountings . . . types of bearings . . . shaft extensions . . . and other similar problems.

Dumore doesn't just sell motors—Dumore offers you an *ENGINEERING SERVICE*—to assure the complete solution of your power requirements — more *POWER HOURS* for your money — a smoother flow of power, day after day — years longer.

Dumore makes a complete line of series universal motors—1/600 to ¾ h.p.—D.C. or A.C., 0 to 60 cycles . . . the ideal drive for thousands of machines . . . husky shop grinders to fine jeweler's lathes . . . aircraft retractable landing gears to delicate telescope controls . . . all with smooth, dependable performance. You should have the handy Dumore catalog. Mail the coupon for your copy and for engineering service application blank.

ANOTHER MANUFACTURER SELECTS DUMORE MOTORS

Hospital equipment requires unusually quiet and *dependable* power. That's why a Dumore motor was selected to operate the hot-water pump on Dr. Elliot's heat-treatment machine (built by the Webster Electric Co., Racine, Wis.) This apparatus—popular with medical authorities for treatment of infections—is unique. Another case where Dumore Engineers solved a power problem peculiar to a particular product.

THE DUMORE CO.
Racine, Wis. Dept. 126-D

Send me your latest Dumore Motor Catalog and Engineering Service Application Blank.

Name.....

Firm Name.....

Address.....

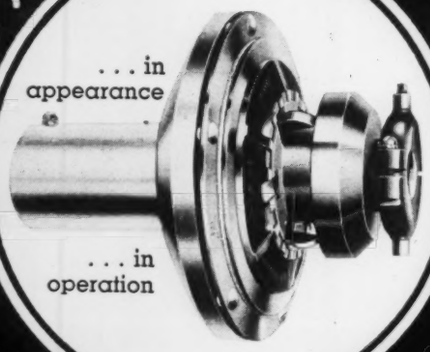
City.....State.....

DUMORE
FRACTIONAL HORSEPOWER
MOTORS

Smooth

. . . in appearance

. . . in operation



Because of its sensible design, wherein its many salient features are a combination of old type clutch superiorities — plus patented improvements, the Conway Disc Clutch presents a *tool of refinement* to better machine performance.

Designing engineers will welcome Catalog P-20, fully illustrative of its dozen features. May we furnish a copy?

THE CONWAY CLUTCH CO.

1546 Queen City Avenue
CINCINNATI, OHIO

Reduces Shaft Friction

The tapered edge of the leather washer of the Gits Precision Oil Seal reduces shaft friction. Only the slightest pressure at this point forms an effective oil seal.

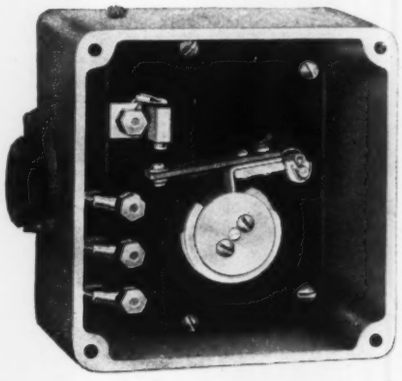
Precision Oil Seals are just that . . . they are accurately machined to very close tolerances. They are equally efficient on horizontal or vertical shafts.

A folder will be mailed at your request.

GITS BROS. MFG. CO.
1861 So. Kilbourn Ave., Chicago, Ill.

GITS Precision Oil Seal

ratios of closed and open circuits within the fixed limit of the time cycle. This range varies with the number of cams on the drum but can be provided for 95 per cent on and 5 per cent off or the reverse. One of the switch contacts is attached to an insulated arm which travels over



Repeating interval timer is powered by a small synchronous motor. Cams on the drum control the frequency of contact

the cam and, as it rises and falls, makes or breaks with the opposite contact which is of the compression type. Two types of switch action are provided, depending upon the rotating speed of the cam shaft.

Offers Unusual Molding Material

FOR MOLDED parts in which the unusual combination of qualities—acid resistance, frictional wear resistance, and low water absorption—are required, General Plastics Inc., North Tonawanda, N. Y., has brought out a new Durez molding material, 77 SB Black. This material has a weight of only 20.6 grams per cubic inch or a specific gravity of 1.26, and a water absorption rate of 0.2 per cent ASTM. In addition, it resists all the common concentrations of acids. An unusual feature of the material is that it can be machined, sanded and buffed after molding without exposing spots of filler or impairing its acid or friction-resistant qualities.

Announces Oil Burner Pumps

PUMPING units especially designed for application to domestic oil burners, incorporating an adequate strainer, a pressure regulating and cut-off valve, and a pumping unit of 18 or 26 gallon per hour capacity, have been introduced by Viking Pump Co., Cedar Falls, Iowa. The valve and strainer section in the unit, shown herewith, is detachable from the pump proper made for an easily acceptable internal loop when

a single line system is installed. There are ports provided for pressure and vacuum gages and the unit is offered with a selection of four standard mounting brackets. The design is compact and is balanced evenly both above and below the center line and on either side. The casing is streamlined to set off the modern burner.

New pump is especially designed for use with equipment where appearance is important

Primer Coat Has Rubber Base

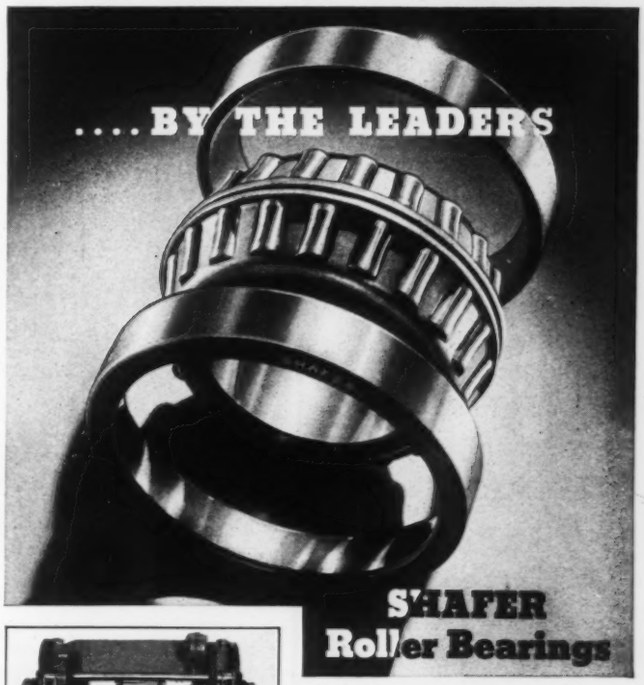
INTRODUCTION of an improved one-coat primer adhesive for use with impervious surfaces such as glass, metal, etc., which gives a highly tenacious bond has been announced by Self-Vulcanizing Rubber Co. Inc., Room 513-A. 605 West Washington boulevard, Chicago. This material, marketed under the name of Selfvulc "M" bonding solution, is completely waterproof. For protection against corrosion, a single coat of the bonding solution is sufficient, without the use of any other material.

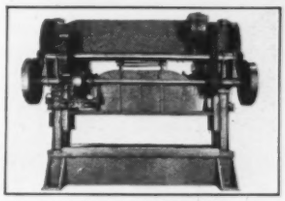
Lamps May Be Built Into Machines

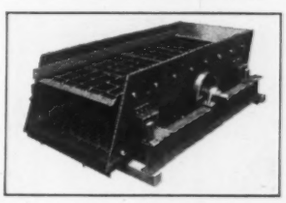
DESIGNED for machines where a small size localized lighting unit is desirable, the new smaller machine lamp offered by Fostoria Pressed Steel Corp., Fostoria, O., follows closely the design of earlier models. Ball and socket joints are retained for maximum flexibility with

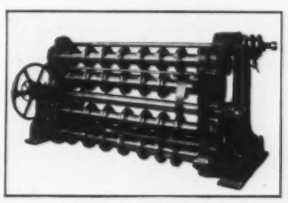
Small machine lamps may be included in the design of the original equipment

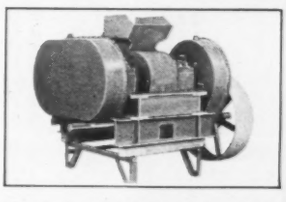
PREFERRED











★ Leading machine builders—in hundreds of different lines—prefer Shafer Roller Bearings. Because of this preference the list of users grows greater every day. These users have found that the exclusive Shafer CONCAVE roller design safeguards performance even under the severest operating conditions.

Only Shafer combines in one simple, efficient bearing these essential features: 1. radial-thrust roller bearing capacity, 2. integral self-alignment, 3. simple adjustability. Only Shafer delivers the full measure of generous capacity, free-rolling action, automatic compensation for mis-alignment, and long, trouble-free, power saving performance.

Available in a full range of sizes: Pillow Blocks • Take-up Units • Hanger Boxes • Cartridge Units • Duplex Units Flange Units • Radial-thrust Roller Bearings. Write for Catalog 12.

★

SHAFER BEARING CORPORATION, 6513 W. Grand Ave., Chicago

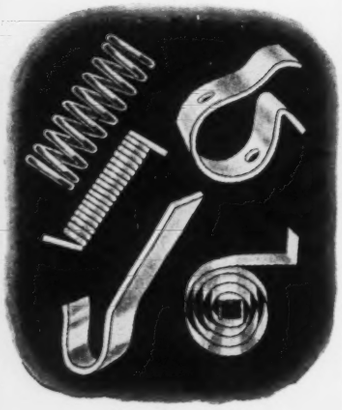
SHAFER

SELF-ALIGNING ROLLER BEARINGS

Springs

FROM LIFELESS METAL TO VIBRANT ENERGY

Way back where the wire begins, GIBSON engineers plant the roots of spring quality. From then on, each step in design, tempering, quenching and coiling receives the extra care and inspection that are typical of modern precision mechanisms. You can depend on GIBSON to drive unswervingly up the path of your specifications—for GIBSON methods and machinery are as modern as the springs they make.



GIBSON-SPRINGS

WM. D. GIBSON COMPANY
1010 WILLOW STREET
CHICAGO, ILLINOIS

Use Nos. 53 and 55
for Large Volumes
---High Pressures

Helical Gears and Ball Bearings insure quietness and dependability in supplying oil under pressure for hydraulic operations of machines.

Ask for Catalog on Geared, Vane and Centrifugal Pumps.

Brown & Sharpe Mfg. Co.
Providence, R. I.

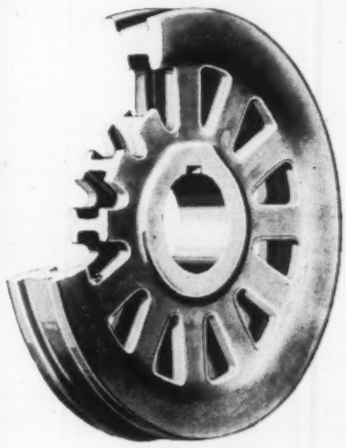
BROWN & SHARPE PUMPS

B·S

sufficient rigidity to withstand the shocks and vibration of modern machine operations. The specially designed reflector, reduced in size, offers direct, glareless light with either 15 or 25 watt bulbs. The base of the lamp, drilled with ¼-inch holes, may be bolted directly to equipment, or to a special clamp that eliminates the necessity of drilling equipment for attachment. Standard colors are black and green, although the lamps may be furnished in any finish desired, including chromium.

Equalizes Wheel Sections

TO OBTAIN full advantage of the characteristics of 13 per cent manganese steel, and to eliminate the possible breakage of the webb, engineers of American Manganese Steel Co., Chicago Heights, Ill., have designed the double wall crane wheel shown herewith. The walls are continuous with the flanges, giving them a strong but elastic support and high resistance to side thrusts. The walls are integrally tied together with internal cross spokes. Metal sections are equalized, making possible, in manganese steel foundry practice, a perfect heat treatment resulting in the maximum toughness in the steel.

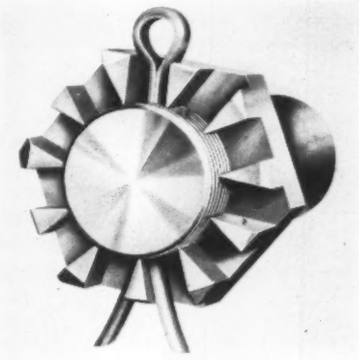


Double wall crane wheel makes full use of the characteristics of manganese alloy steel

Nut Has Many Adjustments

FROM 10 to 22 adjustments per turn (depending on the size) are offered by the Cooke micro slotted nut now being manufactured by Blatchford Corp., 80 East Jackson boulevard, Chicago. This micromatic adjustment is achieved by locating the keying wedges off center from

one another so that two keying positions are possible for each slot. At keying position, a wedge enters the hole. If hole and wedge are not in keying position at first trail, a slight tightening will bring a wedge into position at



Unique locking nut may be adjusted to an unusual number of positions

one end or the other of the hole for the key to be inserted. The key is set by simply tapping it in with a hammer.

Unit Simplified Valve Setting

TO SUPPLEMENT automatic control systems, Foxboro Co., Foxboro, Mass., has developed a new remote valve control. The new control, mounted on a centrally-located panel enables the operator to adjust manually the degree of opening of an out-of-the-way, inaccessible valve without moving from his station. With it, he can reset a valve several hundred feet away to control temperature, pressure, flow or liquid level.

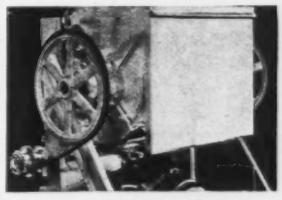
Remote valve control supplements automatic control systems and enables the simple adjustment of out-of-the-way inaccessible valves

Industry's Black Sheep

N.P.L.
[NEEDLESS POWER LOSS]

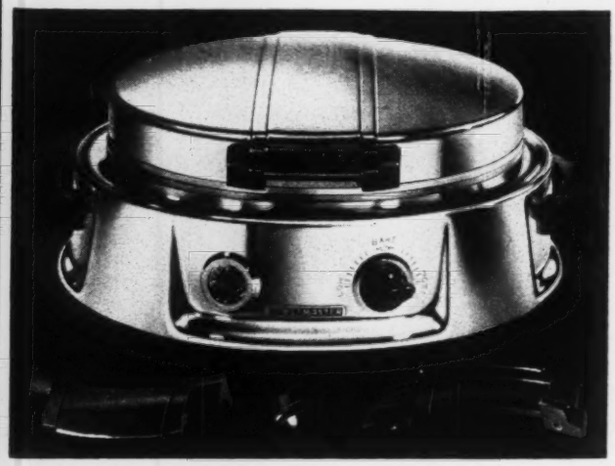
BANISH this black sheep N. P. L. (Needless Power Loss) from your plant. Stop letting him feed on your profits . . . interrupting your production . . . burdening your maintenance costs. It's easy to get rid of him. The nearest Morse sales engineer will help you.

First cost of Morse Chain drives is actually less than other drives in most applications. Before you buy any drive, compare prices. And remember, more value in a positive chain drive than any other — lower maintenance as well as low first cost.



MORSE CHAIN COMPANY
ITHACA • NEW YORK
Division of Borg-Warner Corporation

MORSE Positive DRIVES
SILENT CHAIN and ROLLER CHAIN DRIVES • COUPLINGS • CLUTCHES



LUSTROUS BLACK AND RICH CHROMIUM

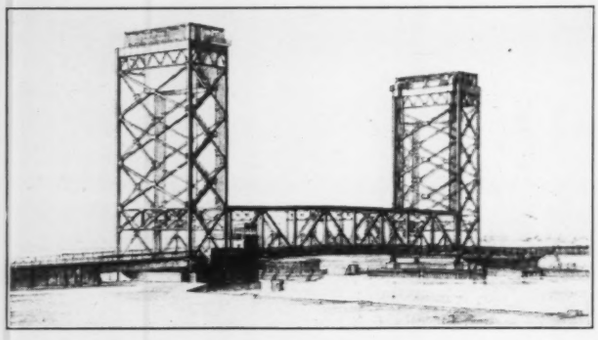
Beauty and quality have long been distinguishing characteristics of Toastmaster Appliances, and the new Toastmaster Waffle Baker is a worthy addition to this famous line.

It is only natural that in selecting their supplier of molded parts, McGraw Electric Company should choose an organization whose standards and facilities match their own. The handle and knobs of the new Waffle Baker are a few of the many parts we have produced for this organization.

Perhaps you too will find this a good place to secure your molded parts. May we consult with you on your next molding job?

CHICAGO MOLDED PRODUCTS
CORPORATION

2147 Walnut Street *Chicago, Ill.*



Another Tribute to BANTAM!

THE Torrence Avenue Bridge, now being built over the Calumet River in Chicago, has a direct relation to your bearing problems—no matter what size you may use. Awarding the order to Bantam for eight roller bearings each weighing thousands of pounds to lift this span is just one more illustration of industry's confidence in us to solve difficult bearing problems.

A TIP FOR YOU

Take a tip from these bridge engineers, from the steel mills and the automobile manufacturers—all of whom are showing an increasing preference for Bantams for many uses. When you need bearings to do a big job, or when you need them to do a small job in a big way—*take your toughest bearing job to Bantam.* Our facilities and resourcefulness are doing the "impossible" for others. Perhaps we can do as much for you.

THE BANTAM BALL BEARING CO.
(Subsidiary of The Torrington Co.)
SOUTH BEND, INDIANA

BBB TAKE YOUR TOUGHEST BEARING JOB TO BANTAM

Calendar of MEETINGS *and* EXPOSITIONS

ENGINEERS are an extremely busy group of men . . . . Their time is especially valuable . . . . So, to these men, the large expositions scheduled for this summer should have an extra appeal * * * Large expositions do not, as a rule, offer detailed technical data . . . . They do, however, permit the engineer to determine by an overall consideration of many fields the information best adapted to further study * * * Most centrally located of the scheduled exhibits is the mammoth Great Lakes Exposition to be held at Cleveland June 27 to Oct. 4 . . . . The Southwest and all visitors to that section will be able to attend another mighty show at Dallas, Texas, where the Texas Centennial Central Exposition is to be held from June 6 to Nov. 29 . . . . Repeating the success of last year, the San Diego exposition will be open throughout the summer.

April 13-17—

American Chemical society. Semiannual convention to be held in Kansas City, Mo. Dr. Charles L. Parsons, 728 Mills building, Washington, is secretary.

April 20-21—

American Gear Manufacturers association. Twentieth annual convention to be held at Adelphia hotel, Philadelphia. J. C. McQuiston, Penn Lincoln hotel, Wilkinsburg, Pa., is manager-secretary.

April 20-24—

Midwest Power Engineering Conference and Midwest Engineering and Power Exposition. Conference to be held at the Palmer House and exposition at International Amphitheatre, Chicago. G. E. Pfisterer, 308 West Washington street, Chicago, is secretary.

April 20-25—

Oil Equipment and Engineering Exposition. Seventh annual exhibition of machinery and equipment is to be held at the Convention Hall, Houston, Texas. E. G. Linzner, P. O. Box 490 Houston, Texas, is general manager of the exposition.

April 22-23—

Association of Iron and Steel Electrical Engineers. Spring engineering conference to be held at Youngstown, O., under auspices of combustion engineering division. Brent Wiley, 1010 Empire building, Pittsburgh, is managing director.

May 4-9—

American Foundrymen's association. Annual meeting and exposition of equipment to be held at Convention Hall, Detroit. C. E. Hoyt, 222 West Adams street, Chicago, is secretary.

June 15-20—

American Society of Mechanical Engineers. Semiannual meeting to be held in Dallas, Texas. C. E. Davies, 29 West Thirty-ninth street, New York, is secretary.

Isolate Vibration—If It Must Be Present

(*Concluded from Page* 36)

resilience. Its effectiveness in reducing transmitted vibration in the direction of force *F* is greater when placed as shown in *Fig.* 7*A* than when placed as at *B*.

Generally it is necessary to design the isolator so that its horizontal cross-sectional area is capable of supporting the load (with no danger of crushing) so that it is a good isolator in the vertical plane. For a given isolating material and a given frequency to be isolated, the effectiveness of the isolator vertically is dependent upon the load upon it and therefore upon its cross section. Without changing the effectiveness in the vertical plane we may improve its isolation value in one horizontal plane by dividing it into strips in the proper direction.

Five methods of arranging isolating material which appear to satisfy the majority of cases met with in practice are shown in *Fig.* 8. These designs (patent applied for) are described as follows:

1. The horizontal vibrations to be isolated predominate in the direction of the arrow. Note that this arrangement would serve to give resilience in the direction of the arrow and comparative stiffness at right angles.
2. The horizontal vibrations are of approximately the same intensity in the two horizontal directions.
3. Horizontal vibrations in both directions are appreciable but more isolation is required in the direction of the long arrow.
4. In this case vibrations are torsional.
5. This is an arrangement which satisfies the same requirements as 1.

All of the foregoing arrangements give increased isolation efficiency in horizontal directions compared to a solid or uncut pad of the same cross section. Various combinations of these arrangements might be found desirable in special cases. For example, a machine might require isolation such as shown at 1 in *Fig.* 8 and at the same time torsional isolation as shown at 4. The resulting pad would be a combination of the two.

Numerous other modifications of the five arrangements suggest themselves, but do not offer anything new to the idea. For example, the portions of the isolating segments in 4, *Fig.* 8, near the center may be cut away or the concentric rings in 5, *Fig.* 8, might be sliced in directions along various diameters. Another modification would be to substitute a circular cross section for the small square pads of 2, *Fig.* 8.

SPECIAL ROLLED SECTIONS

are often the key to important economies

THE variety and intricacy of the sections that can be rolled on Bethlehem's bar mills hold forth the opportunity to sharply reduce costs on the production of many parts.

One of the numerous special sections that have been rolled by Bethlehem is shown above. This is just a suggestion as to what can be done on bar mills. This class of steel product was pioneered and developed to its present broad range of utility in Bethlehem plants. Both experience and facilities place Bethlehem in a position to roll the most difficult sections with satisfactory results.

By calling Bethlehem engineers and metallurgists into consultation, you can be sure of realizing the full latent possibilities of this rapid, economical method of turning out intricate steel parts.

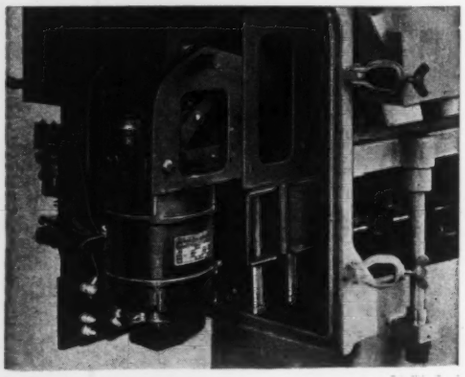
BETHLEHEM STEEL

Bethlehem Steel Company

General Offices: **Bethlehem, Pa.**

Bethlehem District Offices are located at **Albany, Atlanta, Baltimore, Boston, Bridgeport, Buffalo, Chicago, Cincinnati, Cleveland, Dallas, Detroit, Honolulu, Houston, Indianapolis, Kansas City, Los Angeles, Milwaukee, New York, Philadelphia, Pittsburgh, Portland, Ore., Salt Lake City, San Antonio, San Francisco, St. Louis, St. Paul, Seattle, Syracuse, Washington, Wilkes-Barre, York.** ***Export Distributor:*** **Bethlehem Steel Export Corporation, New York.**

HOLTZER-CABOT MOTORS



QUIET—RUGGED—DEPENDABLE

Manufacturers of motor driven apparatus and appliances have found HOLTZER-CABOT Motors built to fit the job, give best results.

Our engineers have a wealth of experience. Let them shoulder your motor problems.

Write Dept. 14 for bulletin.

HOLTZER-CABOT ELECTRIC CO.
125 Amory St. Boston, Mass.

MOTOR SPECIALISTS

PRESSURE
R-C
ROTARY POSITIVE UNITS
VACUUM

MEASURED DISPLACEMENT
with each revolution of the impellers

When successful operation of a machine requires the movement of definite amounts of air or gases, an "R-C" Rotary Positive Blower or Vacuum Pump will provide a satisfactory solution to the problem. Volume is in direct proportion to speed of operation. Many standard sizes. Special units to order.

Roots CONNERSVILLE BLOWER CORP.
CONNERSVILLE, INDIANA

Topics of the Month

(*Concluded from Page* 22)

emerges Wide World Photos, a *New York Times* subsidiary, with a revolutionary system. While the process is basically similar to the Associated Press Wirephoto and Hearst Photophone systems, it utilizes ordinary telephone connections, portable transmission equipment and greatly simplified receiving apparatus.

* * *

Transmission of thought, either verbally or by means of the printed word, always has depended on the ingenuity of engineers. From time to time the idea of recording voice on magnetized steel tape has been suggested. Now we hear that two new types of dictating machines employing this means instead of wax cylinders have been developed in Germany. It is said that a method of magnetizing wire so that sound can be recorded on it was invented in Germany about two years ago. The tape used in the "Dailygraph" and "Magnetphone" as the machines are called, is demagnetized by a mechanism that "cleans" it, ready for reuse. One type of tape used is paper, coated with steel particles, making it possible to cut any desired length with a pair of shears.

* * *

Signs of the times betoken greater emphasis on technological development. We see the effect of this already in such innovations as air conditioning for which the National Better Business Bureau is attempting to find a truly representative definition. The term is often misused and confused, so the efforts of this body in collaboration with technicians of the Air Conditioning Manufacturers' association and the American Society of Heating and Ventilating Engineers are highly commendable.

* * *

Remember free wheeling? In 1931 a total of 407,590 or 21 per cent of the cars were so equipped. In 1932 the figure rose to 37 per cent; then in 1933 it fell to 33, and the following year to 32. Last year it is estimated that only 5 per cent had free wheeling. The story behind extreme pressure lubricants and their use in automobile operation is the opposite; 57,205 cars in 1930 required that type of lubrication, and by 1934 this had risen to 812,812.

Checking Theory with Tests in Bearing Design

(*Concluded from Page* 39)

German practice of Lasche-Korner consists of considering the sum of two partial coefficients of friction, $f + f'$, the first referring to lower load-carrying part and the second to the upper part. Thus they obtained for the lower part $f = .0062$ and for the upper $f' = .0029$ from which the total coefficient of friction was found to be $f + f' = .0091$. The bearing was 8 x 16", r.p.m. = 1350 and 90 lb. per sq. in. pressure.

For example, let us consider a large bearing relieved on both sides to 45 degrees, $D = 22$ inches, L = 33 inches, pressure equal to 175 lb. per sq. in., r.p.m. = 1800, oil outlet temperature 77 degrees Cent., cooled in cooler to 57 degrees Cent. Assuming the temperature of the oil film as equal to the outlet temperature of 77 degrees Cent., the losses in the lower part will be equal to 59.7 kw. and the losses in the upper (assuming the constant clearance of .04 inch) will be equal to 31.1 kw., and thus the total losses = 90.8 kw. There are no methods for calculating the losses in the reliefs. These losses are produced by turbulence of the oil and might reach quite a large figure. Calculating the losses there as in the upper part we have for our case to add 10 kw. more, thus bringing the total losses to 100.8 kw. If the calculation were based on 70 degrees Cent. the total losses obtained by this method would amount to 118.9 kw.

The losses in large bearings may be readily calculated from the expression

$$kw\ Losses = .1 \times \Delta t \times Q$$

where Δt is the drop in oil temperature from inlet to outlet and Q is the amount of cooling oil flowing in gallons per minute. This method is employed for quickly checking the theoretical values obtained by other methods. Since in large bearings most of the heat generated by friction is carried away by the circulating oil and in turn by the cooling water the method is better applicable to large than to small bearings. Thus, for example, if the temperature drop of the oil is 20 degrees Cent. and the flow 60 gal./min., the total measured losses will be approximately 120 kilowatts.

It has been found that reliable and practical data for bearing design can be obtained and gathered for further reference from testing only actual full size bearings. As in many other problems where friction phenomena comes into consideration, tests on models applying the laws of similarity did not always prove satisfactory.

THIS REPORT IS FOR EVERY PLANT OPERATOR

1. A STUDY ON LIGHTING—
prepared in cooperation with the Better Vision Institute and the Better Light-Better Sight Council to make it an authentic study.

2. LIGHTING STANDARDS—
effect plant efficiency. Have the S-W Paint Engineer check yours against the "Standards" table.

3. LIGHT REFLECTION—
can make walls and ceilings work. This "Analysis of Plant Conditioning" tells how.

4. EIGHT PAGES OF PHOTOS—
show graphically, paint's important part in modern industry.

5. 18 CHECK POINTS—
to check your industry for all paint's maintenance, appearance and lighting factors.

6. YOUR UNIT COSTS—
may be reduced by proper painting. You'll be interested in how Time Study Engineers have found paint to help.

7. CASE HISTORIES—
reported by technical engineers are offered as the most convincing way of telling the painting story in plant interiors.

8. PAINT AND PAINTING—
information tells you the right paint for every condition and how to use it to greatest advantage.

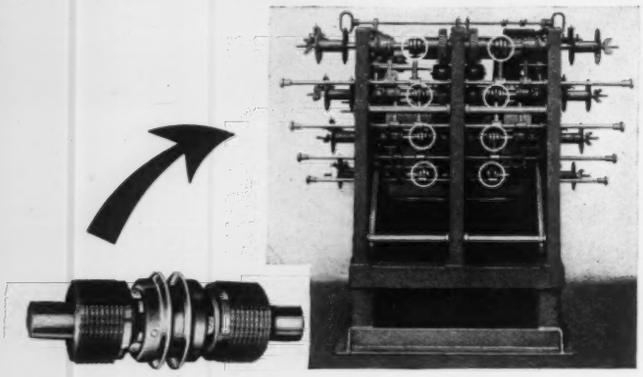
9. A GRAPHIC CHART—
tells at a glance the right paint—from foundation to roof—to assure maximum service at minimum cost.

10. FREE TO PLANT MEN—
this guide to "plant-conditioning" contains photos, charts and useful data. Fill out the coupon below, for your free copy of this new and practical catalog.

The Sherwin-Williams Co., Dept. 1MW-10, Cleveland, O.
Please send me without obligation, the S-W Save-Lite Catalog.
Name & Position.....
Company & Address.....
City & State.....

SHERWIN-WILLIAMS
SAVE-LITE
THE PLANT CONDITIONING PAINT

8 PULLMORE CLUTCHES
Used In Spooling Machines



Eight Pullmore Double-type Clutches are used in the wire spooling machine, shown above, which is a product of Sleeper & Hartley, Inc., Worcester, Mass. These machines are designed for high production with precision and economy. Pullmore Clutches are used because they are "absolutely reliable . . . compact . . . easy to adjust." The same reasons plus the fact that Pullmore Clutches are highly efficient, durable, and easily incorporated in any machine design; are responsible for the successful application and performance of Pullmore Clutches in other kinds of machinery. Purchasing agents, designers, engineers, and other executives intcrested in reliable low-cost power transmission and control are urged to investigate Pu lmore Clutches. Catalog, and details of our free engineering service will be supplied promptly on request.

ROCKFORD DRILLING MACHINE CO.
Division Borg-Warner Corp.
304 Catherine Street, Rockford, Illinois
Sold by MORSE CHAIN CO., Ithaca, N. Y. Offices in principal cities

Look at This Important Detail of Construction

FULLY SUPPORTED—Note carefully how the curvature of the leather sealing member is backed up by the curvature of the steel inner shell.

This construction provides a substantial support for the sealing member. It keeps it from "balling up" and wearing prematurely. It is responsible for the long life and sealing power in Milpaco Oil Seals.

MICHIGAN LEATHER PACKING CO.
724 Fourteenth Avenue, Detroit

MILPACO
OIL SEALS

5-202

Consider the Pump—Vital Part of Machines

(*Concluded from Page* 33)

course, be proportionately smaller. Large pipes cause less friction losses and also act as reservoirs. On suctions feeders having valves which quickly open and close for feeding the sheets, the pipe line should be quite small between the valve and the sucker. The pipe line from the valve to the pump should be kept large.

Designers should provide a dust trap or filter on the vacuum line ahead of the pump to protect the pump. Air pumps are closely fitted and dirt will spoil these fits. Air charged with acid fumes may be allowed to bubble through an alkaline solution to neutralize the air before it enters the pump. A few pressure blowers discharge some lubricating oil with the air, therefore an oil separator should be placed in the line if this oil is objectionable.

Velocity Is Reduced

With the pump size remaining constant, the higher the vacuum, the less is the velocity through the piping. At high vacuum, 29 inches for instance, there is practically no velocity, there being principally a static condition.

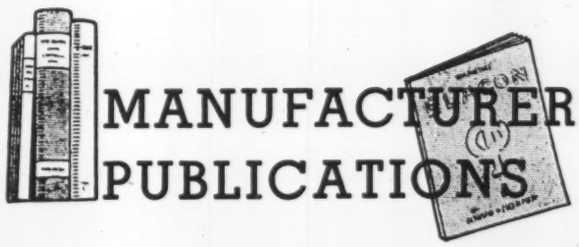
A higher vacuum than is necessary should not be used as the efficiency of the pumps decreases as the vacuum increases. This causes a waste of power and causes undue wear on the pump. Pumps perform more efficiently at 15 inches than at 20 inches, and more efficiently at 20 inches than at 25.

Pumps do not operate efficiently under both vacuum and pressure at the same time. When a pump is run under vacuum, the air flow is being held back from the pump and the outlet air is therefore cut down in volume. At a vacuum of about 29 inches there would be practically no air coming from the outlet to be used for pressure.

Individual pumps should be used on individual applications. If one pump is used to operate the vacuum on several operations, the failure of one will affect the others. For example, if one pump is used to operate a series of suckers at various points on an automatic machine, and a piece should not be picked up by one sucker, all other pieces will be dropped by the other suckers.

A good design precept to remember in planning all machinery is that the lifting power of suction cups is in proportion to their area; therefore, it is wise to make the cups large and keep the vacuum low.

For their considerate assistance in the preparation of this article due acknowledgement is made to Leiman Bros. Inc., and Roots Connersville Blower Corp.



MANUFACTURERS' PUBLICATIONS

ALLOYS (NICKEL)—A new bulletin on the use of various metals and alloys for equipment in the manufacture of pharmaceuticals and fine chemicals has just been issued by International Nickel Co. Inc., 67 Wall street, New York. Several of the newer materials are described in the bulletin, among them being K Monel, a hardenable alloy made from Monel metal by introducing small quantities of aluminum.

ALLOYS (STEEL)—New applications of Silcrome stainless steel are attractively illustrated and described in a bulletin of Ludlum Steel Co., Watervliet, N. Y. These applications include food, process industry, transportation and metalworking machinery.

BEARINGS—Link-Belt Co., 307 North Michigan avenue, Chicago, has prepared a 40-page catalog, No. 1520, on its line of anti-friction bearing units available in streamlined pillow block, hanger, takeup, flanged, duplex and special mountings. Five distinct types of bearing units are covered.

BEARINGS—Norma-Hoffmann Bearings Corp., Stamford, Conn., has prepared a most comprehensive bulletin, No. F-951, on its line of cartridge type precision ball bearings. This type of bearing permits considerable simplification in bearing applications and safeguards against carelessness or neglect of lubrication.

CONTROLS (ELECTRICAL)—Ward Leonard Electric Co., Mount Vernon, N. Y., has issued new catalog inserts on ring type rheostats, constant voltage variable load regulators, controlled rectifiers and enclosed motor field rheostats.

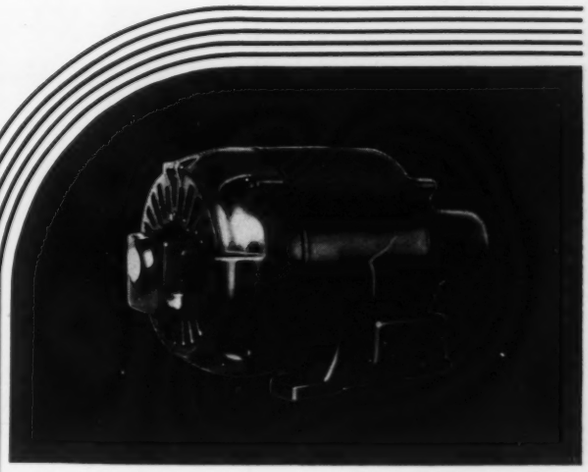
COUPLINGS—Lovejoy Tool Works, 5018 West Lake street, Chicago, is distributing a folder which describes the company's new flexible coupling which has freely floating load cushions.

DESIGN DEPARTMENT—Details on the new compact, continuous printer of C. F. Pease Co., 806 North Franklin street, Chicago, are covered in a new publication of the company which presents the characteristics of the machine and the type of work which it will perform.

DESIGN DEPARTMENT—A convenient, pocket-sized chart which includes a hardness conversion table for constructional alloy steels, and a comprehensive chart showing the approximate relations between Brinell, Rockwell and Shore hardnesses and the tensile strengths of constructional alloy steels is being distributed by International Nickel Co. Inc., 67 Wall street, New York.

DRIVES—Janette Mfg. Co., 556 West Monroe street, Chicago, is distributing a new folder which describes the latest additions to the company's line of motorized speed reducers.

DRIVES—Ramsey Chain Co. Inc., Albany, N. Y., has

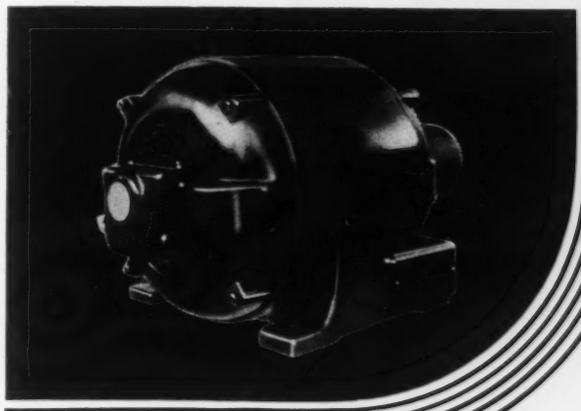


ARE YOU OVERLOOKING A *Good Safe Bet?*

• Many new names are constantly being added to our list of customers and surely those nationally known companies find very definite advantages in having Peerless Heavy Duty motors drive their equipment.

Let us send you information on Peerless motors ⅛ to 7½ H. P. in Single Phase, Polyphase and Direct Current types and show you how we can be of real service to you.

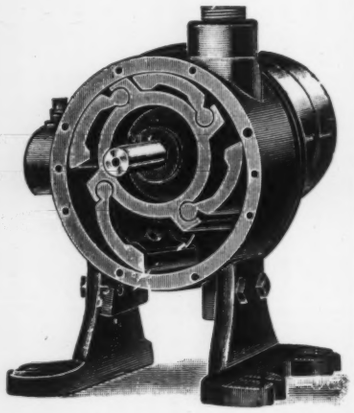
The Peerless ELECTRIC COMPANY WARREN OHIO



The Suction that Lifts and Carries your Paper in the Printing Press, Folder, Addresser, Labeller, Sealer or Bander

This is the heart of the machine

And every machine, like every man, is benefited by having a good heart—one that responds when called upon for its best efforts, not one that quits when it is most needed. And in this instance it costs no more when you get a machine with this good heart—the most powerful and long-lasting air pump made.



LEIMAN BROS.
PATENTED
ROTARY POSITIVE
AIR PUMPS
They Take Up
Their Own Wear

Also Used for VACUUM or PRESSURE	for VACUUM PRINTING FRAMES COOLING MOULDS AGITATING LIQUIDS STEREOTYPE MELTERS	Also Used for GAS and OIL Furnaces

LEIMAN BROS., INC.
177 (4) Christie St., Newark, N. J.
LEIMAN BROS., N. Y. CORP., 23 P4 Walker St., New York City
Makers Of Good Machinery For Over 45 Years

Write for it . . .

● YOUR SAMPLE FILE of the standard types of felt—bound into a chart classifying applications of each type! Designed to be useful to all users of felt—not for sales follow-up. Mailed without charge.

Booth
PRECISION CUT FELT

BOOTH FELT COMPANY, INC. 444—19TH ST., BROOKLYN, N. Y.

published a booklet entitled "The A-B-C of Silent Chain Drives." The publication covers the construction of the chain, how it operates, what it will do, and details on lubrication and care.

DRIVES—Silver streak silent chain drives are covered in booklet No. 1725 of Link-Belt Co., 307 North Michigan avenue, Chicago. Complete details are tabulated for the wheels and chain constituting each drive; also horsepower and ratio tables. A few simple instructions for selecting a drive from the tables are included, as are notes on design.

DRIVES—Automatic speed regulation of industrial production machines and conveyors is thoroughly discussed in a new publication of Reeves Pulley Co., Columbus, Ind. The booklet tells how automatic regulation is accomplished, describes four types of controls; and tells and shows how they may be connected and used to meet specific requirements in many industries.

HYDRAULIC EQUIPMENT—Sundstrand Machine Tool Co., Rockford, Ill., has prepared a bulletin which gives details on the company's line of hydraulic equipment including pumps, controls and valves. Each part is completely described.

MISCELLANEOUS—Products of the American Brake Shoe & Foundry Co., 230 Park avenue, New York, and its subsidiary companies are shown in bulletin 36 which covers castings of many types, iron alloys, steel alloys, wheels, brake linings and brake blocks, forgings, bearing metals, and welding rods.

MOTORS—Imperial Electric Co., Akron, O., has prepared catalog insert S-38 on its new line of splash-proof squirrel cage motors.

MOTORS—Reliance Electric & Engineering Co., 1050 Ivanhoe Road, Cleveland, is distributing bulletin 117 on its line of wound-rotor motors for two and three-phase alternating current. The bulletin gives a complete description of the motor and an analysis of the parts employed.

PUMPS—New bulletins on centrifugal and rotary pumps are being distributed by Worthington Pump & Machinery Corp., Harrison, N. J.

PUMPS—The latest design of domestic oil burning pumping equipment is presented in a folder of Viking Pump Co., Cedar Falls, Iowa. These pumps are symmetrical, streamlined units designed for building into the equipment.

SPRAY NOZZLES—Patented nozzles designed to produce a flat, fan-shaped spray, insuring complete coverage on any washing or cleansing operation are covered in a bulletin of Chain Belt Co., 1600 West Bruce street, Milwaukee.

WELDED PARTS AND EQUIPMENT—Discussion of improvements in technique and materials for fabricating 18-8 chromium steels is presented in a new booklet of Linde Air Products Co., 205 East Forty-second street, New York. Susceptibility to intergranular corrosion in the base metal zones adjacent to the weld has been found to be eliminated by the presence of columbium or titanium in the steel and of columbium in the rod. Another recent booklet of the company gives a practical presentation of the fundamental theory and technique of bronze-welding and bronze-surfacing.

Business and Sales Briefs

FIELD representatives of International Nickel Co. Inc., New York, have been established at Chicago and Los Angeles. H. L. Geiger, room 1116, 333 North Michigan Avenue building, is the Chicago representative while A. G. Zima, 705 Petroleum Securities building, Olympic and Flower streets, represents the company in Los Angeles.

* * *

Vanadium Corp. of America has removed its general offices to the Graybar building, 420 Lexington avenue, New York.

* * *

Noland Co. Inc., Washington, D. C., has been appointed Toncan Iron sheet distributors.

* * *

National Machine Tool Builders association offices are now located at 10525 Carnegie avenue, Cleveland.

* * *

J. D. Wright and Karl H. Runkle have been appointed assistant managers of the industrial department of General Electric Co., Schenectady, N. Y.

* * *

Reliance Electric & Engineering Co., Cleveland, has added Philip A. Singleton, Philadelphia, and Jack K. Williams, Chicago, to its sales force.

* * *

The name of the Hoover Steel Ball Co., Ann Arbor, Mich., has been changed to the Hoover Ball & Bearing Co. The change was made so that the company's name will be in keeping with and more descriptive of the products manufactured. Management, personnel, financial structure and policies remain the same.

* * *

Offices of American Management Association Inc. have been removed to the McGraw-Hill building, 330 West Forty-second street, New York.

* * *

Foote Bros. Gear & Machine Corp., Chicago, has appointed H. S. Thayer as its representative in the central and northeastern part of the state of New York, with offices at 136 Milnor avenue, Syracuse, N. Y.

* * *

Roots-Connersville Blower Corp., Connersville, Ind., has removed its Chicago branch office to the Marquette building, 140 South Dearborn street. This office is in charge of William Townsend, district manager, assisted by James T. Sutliff, formerly located at the factory.

* * *

C. W. Dietrich Jr. has been appointed sales engineer for Torrington Co., and Bantam Ball Bearing Co. to handle their ball, roller and needle bearings in the New York territory with headquarters at 200 Fifth avenue.

"New Drive Saves Money" reads the headline of a recent advertisement of the Foxboro Company, manufacturers of quality industrial instruments. And the drive to which they referred consists of a Bodine speed reducer motor.

Bodine motors are to be found driving hundreds of other unusual and special machines—calculators, projectors, turntables, traffic signals, and timers, to name but a few. Such machines usually require a motor "tailored" to fit the load. It is here that Bodine motors and Bodine engineering have proved their value.

For over thirty years Bodine has specialized in the design and manufacture of fractional horsepower motors. By concentrating on this narrow field, Bodine engineers have been able to go very thoroughly into intricate design and application problems. The standard Bodine line includes practically every known type of motor, yet Bodine also offers an individual engineering service. Bodine engineers will be glad to help solve your motor drive problems. Write Bodine Electric Company, 2258 W. Ohio Street, Chicago, Ill.

Foxboro advertisement in the August, 1935, issue of METALS AND ALLOYS, featuring the new Bodine motor drive.

BODINE
BODINE
FRACTIONAL H. P.
MOTORS
ENGINEERED FOR YOUR PRODUCT

New York. R. A. Griswold, who came to the sales organization of the Bantam company in 1935, has been assigned the Connecticut and Massachusetts territory.

* * *

Foote Bros. Gear & Machine Corp., 5301 South Western boulevard, Chicago, has taken over all activities and assets of Foote Bros. Gear & Machine Co. This marks the successful completion of a period of reorganization and consolidation of activities.

* * *

Ernest F. Talmage has been engaged by National Tube Co., Pittsburgh, as special representative in promoting the sales of seamless alloy tubes for general industrial purposes.

* * *

W. M. Phares has been appointed district representative in the Chicago district for Peninsular Steel Co., Chicago, with headquarters at 1 North Crawford avenue.

* * *

J. E. Donally has been made sales representative in the St. Louis and surrounding area for LaSalle Steel Co., Chicago. Mr. Donally's headquarters will be at 6108 Oakland avenue, St. Louis.

* * *

Equipment Engineering Co., Minneapolis, has announced that the sale of its variable speed pulleys is now being handled in the Western Pennsylvania territory by Continental Engineering Service, New Kensington, Pa.

The Baltimore division and Baltimore Tube Co. division of Revere Copper & Brass Inc. have been consolidated and hereafter will operate as the Baltimore division of the company. Sales offices are at 1301 Wicomico street, Baltimore, Md. Branch offices are located in Philadelphia, Atlanta and New Orleans. R. H. Hodges is sales manager.

CROSS SECTIONS

DESIGNERS could visualize how the parts of a machine should work together by being in Indiana during the Ides of March. The great Hoosier craze of high school basketball is in full swing during those weeks and no machine ever ran more smoothly than those schoolboy combinations. It's a rash they just can't seem to get rid of out there.

ONE line of machinery that must most certainly be showing improvement is farm equipment. In less than fifty miles through the farm country, on a trip, we saw four new tractors being put through their paces.

THE why of all this new equipment stirred up our over-grown curiosity bump. A dealer whom we asked about it said that last year with excellent crops, unusual-

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ly good prices and prospects for the best year PD, the farmers couldn't get the boys to leave relief to help harvest the crops. You don't see these farmers being caught twice. This year they are getting equipment which will enable them to get all their crops in and collect for them. Maybe the government agencies would find it profitable to check into the proposition before relief becomes necessarily permanent.

AGRICULTURAL machinery isn't the only line where the farmer figures. Today he requires an automobile. We checked '35 and '36 cars through 500 miles of farm country. Plymouth was way out in front in numbers. Higher priced cars are being led by Packard.

MORE automobiles requires better roads, and again the machine industry profits. In the Hoosier state they have roads which could only be brought to their present state of perfection through the use of the most up-to-date machinery. Again the designer makes a valuable contribution.

THERE was one farm boy who just wouldn't be satisfied though. He got rid of his six-cylinder car because he couldn't "Get a mile over 75 out of her." Now he can get greater speed, but the roads aren't wide enough to give him room for doing much over 85 very often.

MACHINES which permit noiseless recording have created a new industry. We were privileged to see the recording of various sounds on records to provide sound effects for radio stations, dramatic presentations, etc., and to hear some of the results. All you have to do is to call for a certain type of noise and they'll play it for you. Noiseless recording gives you the sound without recording noise or static and when it thunders in the studio you start to turn up your collar.

HERE'S help for the beleaguered designer. With training and practice it is comparatively simple to turn out a good mechanical drawing. But when we come to isometric drawings it's another story, and too often a sad one. But now you can sleep nights, for a ruled paper has been developed which will enable the designer to make isometric drawings just as quickly, neatly and accurately as he makes the usual flat views.

CAREFULLY guarded secrets sometimes conceal design methods to such an extent that the interchange of ideas is impossible. However, enlightened companies who have discussed their ideas freely have been able to take advantage of constructive suggestions made by others and thus progress a great deal further than they would have been able to by themselves. One function of MACHINE DESIGN is to aid in this interchange of ideas, a factor of vital importance in the design of machinery.

CONVEYING problems and equipment have progressed to the point where the solution of individual applications has become an art, with equipment exactly satisfying the conditions. It is not so long ago that conveyors were merely an afterthought, hurriedly put together to more or less do the job. A new booklet we recently received shows the extent of this fast-moving industry.

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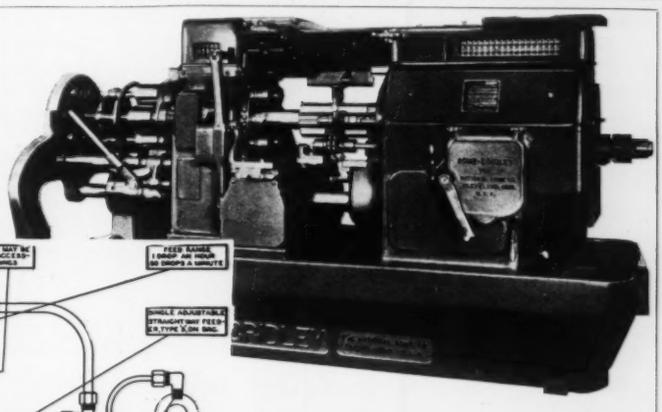

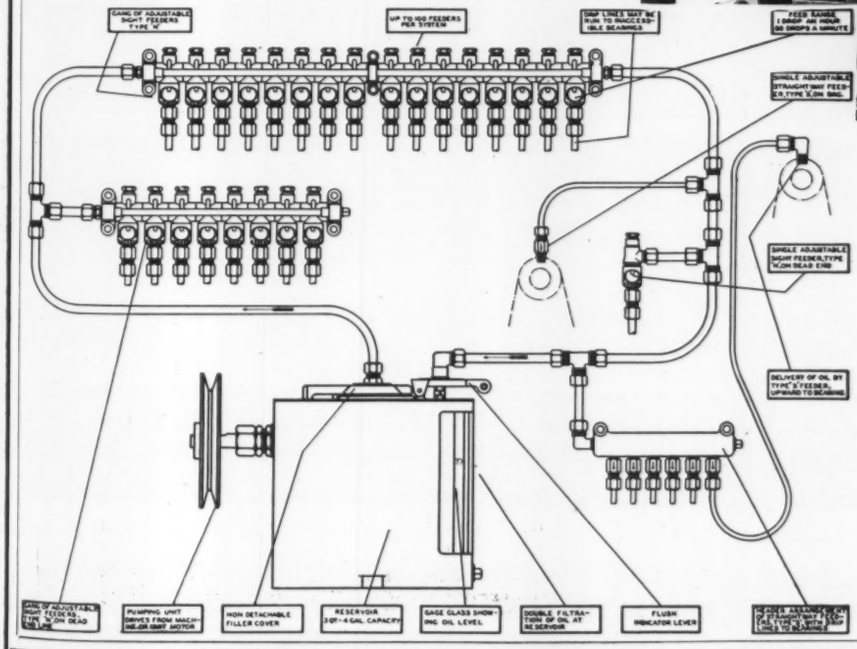

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